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ANNALS OF SURGERY

VOL. 122 JULY, 1945 No. 1

# TRAUMATIC OSTEOMYELITIS: THE USE OF SKIN GRAFTS—PART I

## TECHNIC AND RESULTS

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AND

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DURING THE PAST TWO YEARS an extensive experience with the application of skin grafting to the treatment of osteomyelitis resulting from war wounds has been accumulated at Ashford General Hospital. This procedure is neither new nor original with us. Lord[1] reported Thiersch grafting of osteomyelitic cavities in 1902. Reid,[2] in 1922, published a concise report covering most of the aspects of the subject which we consider important. Armstrong and Jarman,[3] as well as Quick,[4] report the use, the latter over a period of 20 years, of a technic similar to that employed by us. Neuber,[5] in 1895, Lord,[6] and Beekman,[7] somewhat later, have written of the applicability of pedicle skin grafting to the arrest of this condition.

The above reports, collectively, have reference to hematogenous osteomyelitis, as well as to bone infection of traumatic origin. Nevertheless, skin grafting of osteomyelitic wounds has failed to come into the general use which we feel its effectiveness warrants.

One isolated skin grafting procedure has found reasonably wide acceptance and adoption. This procedure is applied to the indolent persisting recurrent superficial ulceration involving scar epithelium and underlying bone seen in old hematogenous osteomyelitis of the tibia. All scarred soft tissue and superficial unhealthy bone in the area is excised. An appropriate relaxing incision is made. The intervening flap is undermined and shifted to obtain *per primam* healing of the involved area, and the former site of the shifted flap is filled in by a free-skin graft.

One of the authors of this paper (R. P. K.) had been impressed with the latter procedure, and while stationed at another Army General Hospital had the opportunity of observing in three cases the effectiveness of free-skin grafting of granulating bone cavities of longer or shorter standing, which resulted from saucerization of osteomyelitic processes. The work to be

presented in this series of reports finds its background in the above observations and in the reported work of Converse[8] on skin grafting in war wounds. That author pointed out that regardless of the bacteriology and apparent degree of contamination of the wound, a "dressing" of skin often resulted not only in a considerable amount of apparently nonspecific benefit to wound healing but in a surprisingly high proportion of "take." In addition to the foregoing, we believe that this work owes great credit to the availability of the dermatome, as developed by Padgett. This instrument places within the grasp of the average surgeon the ability easily to obtain free-skin grafts of desired thickness in reasonably unlimited amounts.

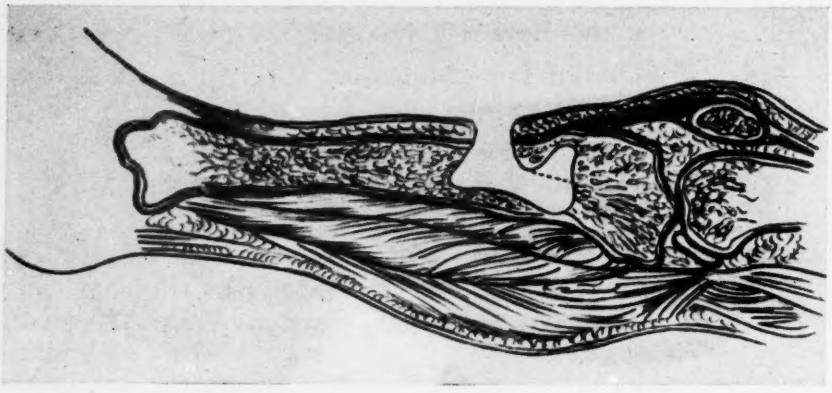


FIG. 1.—Cross sectional representation of wound not suited for skin grafting. The extreme difficulty of applying appropriate pressure to that portion of a skin graft above the broken line is apparent.

## TECHNIC

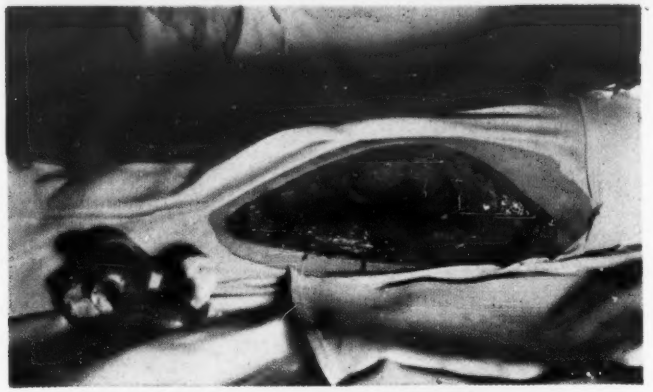
The experience of two years with all representative skeletal structures except the spine and skull, and of approximately 100 osteomyelitic wounds has evolved a technic of wound preparation which at present we consider ideal.

First, every effort is made to improve the patient's general condition. This may require transfusions of whole blood and plasma. Meanwhile, necessary preliminary laboratory and roentgenologic studies are carried out, and local skin preparation, after bivalving the encasement, is begun. Unfortunately for completeness of data, adequate wound cultures are not available in many cases. This point is recorded not with pride but to emphasize our feeling that in this group of wounds individual attention to bacteriology is apparently unimportant. This view is subject to change and we hope to substantiate it or refute it following completion of more detailed studies.

Saucerization is then carried out. This has become an increasingly exacting procedure. As performed, it is analogous to débridement of a fresh wound. It has the additional feature that the wound topography must *approach* a saucer-shape. If this topographic ideal is sufficiently met to permit a satisfactory pressure dressing to be applied over the skin graft which follows, no additional healthy soft tissue is sacrificed. We do not hesitate to sacrifice

A

B



C

D

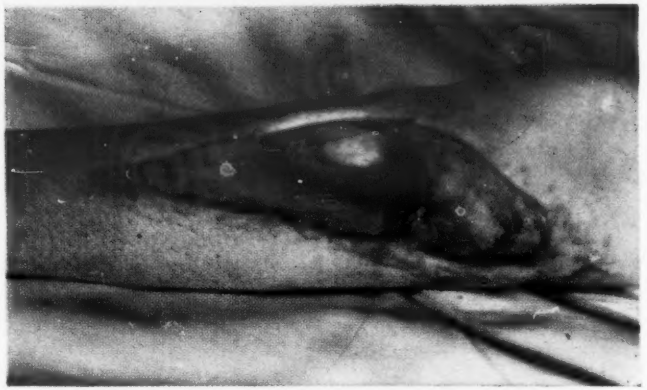


PLATE 1: A. Clinical photograph of right leg three months after shell fragment wounds.
B. Saucerized wound.
C. Completed skin graft 4 days after final saucerization.
D. Healing nearly complete.

bone, provided in so doing the surgically created bone weakness does not exceed that of the preëxisting "weakest link" caused by the pathology under treatment. This rule may be violated where one is not jeopardizing functionally essential stability of the skeletal structure, or when its violation is necessary to permit access to devitalized tissue. For the sake of completeness, it is recorded that great respect is held for the intactness of nerves and major arteries. Wound surgery i begun at the point of juncture of healthy and

FIG. 2.—Case 1: Roentgenogram of right leg three months after shell fragment wounds.

unhealthy skin. A line of cleavage between scar tissue and relatively normal surrounding tissue is developed, followed down on one side to the depth of the wound, thence up the other side to the opposite edge. By following this plan it is often possible to accomplish a complete removal *en bloc* of all unhealthy tissue and of all foreign bodies. Any undesirable tissue not included is subsequently removed. If the skin edges which appeared healthy along the line of excision are fibrosed and scarred on the under surfaces, this scar is removed and skin mobilization back to healthy soft tissue is carried out. Any remaining skin whose vitality is questionable due to the presence of cyanosis or ischemia is further excised. Shaping of the wound to suitable topography (Fig. 1) for skin grafting is then carried out. During the course of this it is common to uncover further small sequestra and extrinsic foreign

bodies. Next, any remaining tissue which, though not frankly scarred, appears of low vitality, and in the judgment of the operator will contribute little to function, is removed. Finally, any tendon denuded of its sheath, or any exposed ligament which will not contribute to the anticipated function of its joint is excised. If such a structure is vital, an effort is made to cover it by shifting a flap of local healthy skin. Lacking this, the structure is sacrificed and subsequent reconstruction is planned.

The wound preparation as outlined above is considered absolutely necessary to satisfactory results. Its accomplishment necessitates careful and

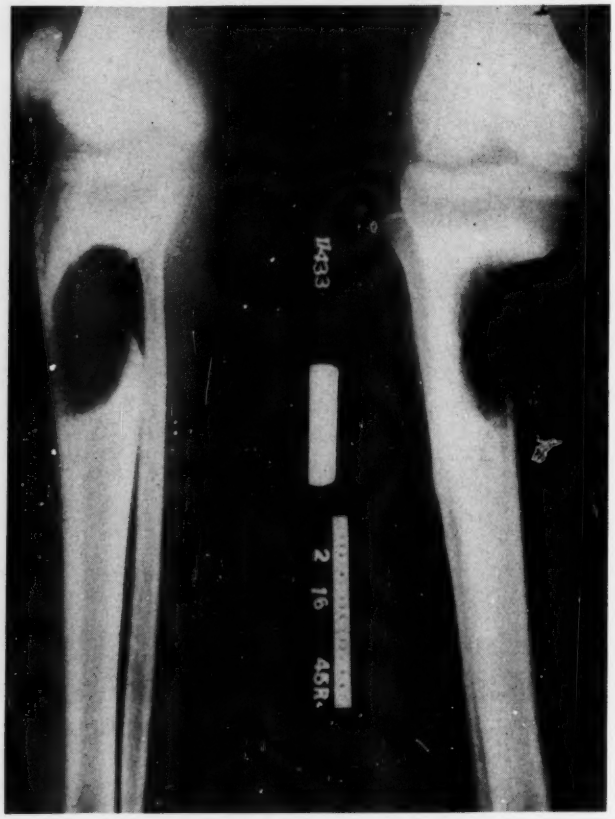



FIG. 3.—Case 1: Roentgenographic appearance nine weeks after skin grafting.

frequently extensive surgery. Thus, the patient's general condition must be the best. The use of a tourniquet in suitable locations is often desirable to minimize otherwise uncontrollable blood loss. Feeling that tissue vitality must be always decreased by its use, we have omitted the tourniquet whenever it was considered safe to do so. Plasma infusions and transfusions of whole blood at operation are commonly necessary. In several severe cases, wound preparation has of necessity been accomplished in stages. The procedure followed in these cases is that of preparing the patient for both saucerization

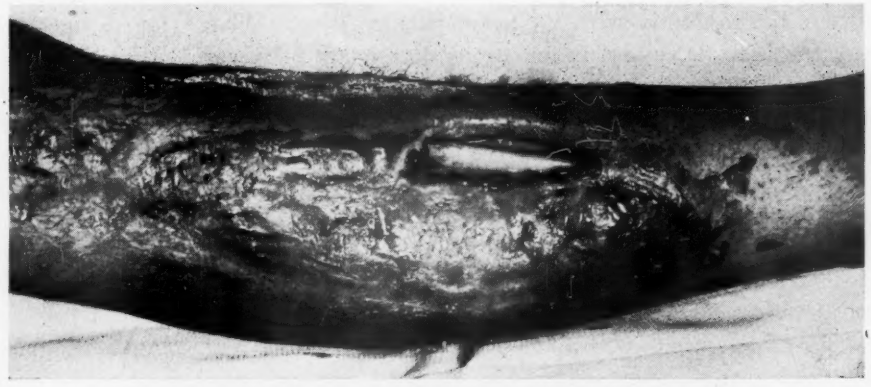


FIG. 4A

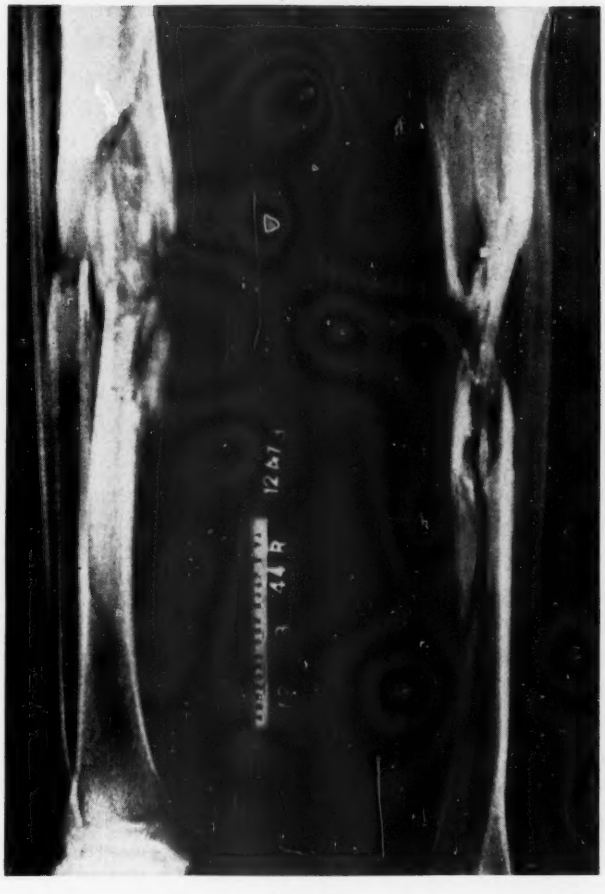


FIG. 4B

FIG. 4.—Case 2: Clinical photograph and roentgenogram of right leg two months after close-range bullet wound.

and skin grafting, and of carrying out further saucerization if the gross appearance of the wound is unfavorable for skin grafting. Where staged saucerization has been necessary, granulations developing in the area untouched since the first operation of the series may have become thick and edematous. In such instances it is our practice, after permitting the patient a rest of some two or three weeks, to "peel" the granulations from the wound as a final preliminary procedure. Thereafter, the wound is treated just as those in which only a single saucerization has been adequate.

Early in the development of this procedure an orthodox *Orr dressing* was applied to the saucerized wound prior to skin grafting. Our present treatment is fundamentally the same, but for two exceptions: We feel that fatty substances on the granulating bed may interfere with vascularization of the skin graft. The same is true of thick edematous granulations. Therefore, the postsaucerization dressing as now employed (Fig. 2) consists of a layer of fine-mesh bandage gauze made as wrinkle-free as possible, in direct contact with the tissues of the wound. Over this is packed a suitable mass of mechanics' waste, to permit of applying, by means of an Ace bandage, as much pressure to the wound as can be made without embarrassing circulation at more distal points. The latter can be minimized by extending the area over which pressure is made in the extremity to the base of the toes or fingers. To permit swelling, with minimal increase in pressure, a thick layer of sheet wadding is wrapped on over the Ace bandage. Following this, plaster immobilization, as for orthodox Orr treatment, is employed. In addition to the dressing as described, more recently a single Carrel's tube has been incorporated into the mechanics' waste portion of the dressing and brought out through the encasement. One per cent solution of acetic acid, in amounts proportionate to the size of the wound, is used as an irrigant through this tube at four-hour intervals. Thus, contamination by *B. pyocyaneus* and *B. proteus* is reduced.

Our early practice was to wait for periods as long as one month between saucerization and skin grafting. *This interval has been progressively shortened,* with increasingly beneficial results. At the present time, skin grafting is usually performed *four days after saucerization.* Simultaneous sequestrectomy and skin grafting have been undertaken on three occasions, with good results. Where adequate saucerization is performed it is preferable to wait three to four days to permit the formation of granulations on relatively avascular cortical bone. Moreover, uniformly healthy granulations however thin, visible after four days of pressure dressing, are an index of a healthy wound likely to respond favorably to grafting.

Immediate local preparation for skin grafting consists merely of bivalving the encasement prior to the patient's going to surgery, and of preparing appropriate donor sites for skin. Sometimes three or four drums of skin have been necessary to provide adequate coverage.

On a flat surface a skin graft can be subjected to some tension without reducing the possibility of applying uniform pressure of a suitable degree over the wound. On the uneven, and often complex, surfaces of these wounds,

tension must be completely eliminated from the graft to permit the possibility of attaining the ideal of uniform pressure at all points.

By resorting to more radical surgery, with removal of a greater amount of healthy tissue, it might be possible to obtain a wound the outline of which did not entail such great difficulty in proper application of pressure to the graft. Wrinkling must be avoided as much as tension. By time and care, and removing "V"-shaped pieces of skin at strategic points about the graft,

FIG. 5A

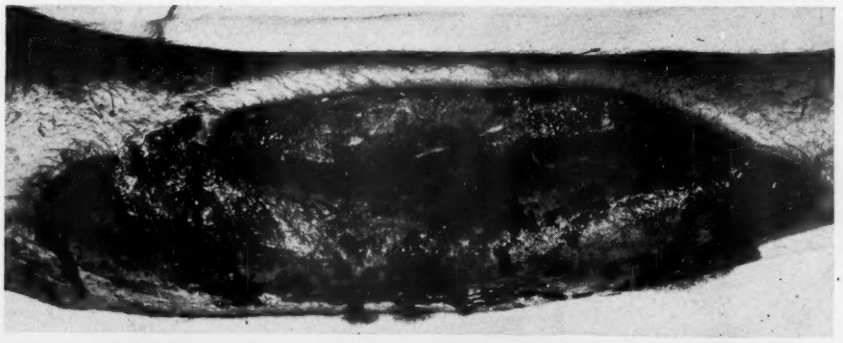


FIG. 5B

FIG. 5.—Case 2: Saucerization was carried out in three stages over a period of six weeks, followed by "peeling" of granulations three days prior to above views. (A) The saucerized wound immediately prior to grafting. (B) The graft sutured in place. Note that in the latter view and in Cut C on color plate the grafts fall of their own weight into the deep recesses of the wounds.

a piece of patchwork, fitting the complicated surfaces of the wound is obtained. Along the secondary suture lines, necessitated by this fitting of the graft, untied running sutures are placed with one end left long. These are withdrawn when the graft has become firmly adherent to its bed. The edges of the graft are sutured to the skin edges with nonabsorbable material. Because of satisfactory results from mechanics' waste as a pressure medium, we have employed a stent in only one case in our series.

Occasionally the open medullary cavity presents at one end of the depth of the saucerized wound. Thus, a gap of small diameter may exist in the granulating bed at this point. This situation is met by making a vertical slit in the portion of the graft overlying the gap. Thus, contact with the bed is

FIG. 6A

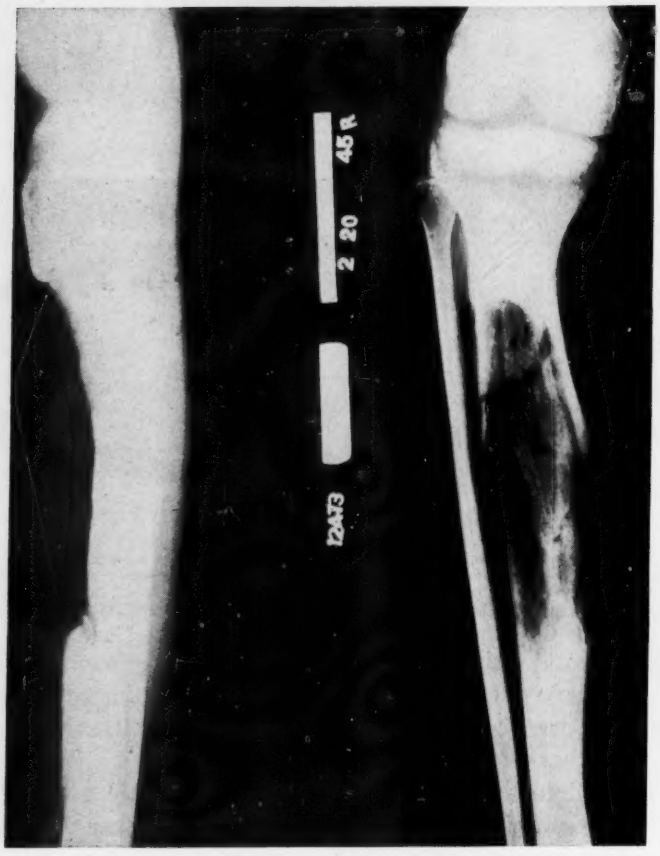



FIG. 6B

FIG. 6.—Case 2: These illustrate (in A) the appearance of the graft on removal of dressing five days after operation, and (in B) the roentgenographic appearance 20 days after skin grafting.

maintained, delayed filling of the gap by granulation is presumed to follow, and it is finally closed by secondary epithelization.

With two exceptions the postoperative dressing is essentially the same as that applied after saucerization. Boric acid gauze instead of plain fine-mesh gauze is preferred in contact with the graft. The pressure applied by the Ace bandage is reduced to the amount suitable for any skin graft, with due allowance for the depth of the cavity. Better results have been obtained when the pressure dressing is irrigated either with a weak acid solution or with penicillin 1:250. This is especially true of the wounds in which considerable drainage develops.

FIG. 7.—Case 2: Appearance of wound nine weeks after surgery. Healing still not quite complete.

In the latter group of wounds, as early removal of pressure dressings as possible prevents loss of graft by maceration. We have found it safe to remove pressure dressings as early as *four days,* but prefer to leave them longer when a minimum of exudate is apparent. An odorless dressing suggests minimal exudation. Rarely is a pressure dressing left in place for more than *six days.*

On removal of the pressure dressing, wound cultures are taken, and gauze compresses are loosely inserted into the wound and kept wet with saturated boric acid solution. Beyond this, the graft is left exposed as much as possible, since maceration is a hazard until such time as all drainage ceases. If, by culture, the organism is penicillin-sensitive, and if *B. proteus* or *B. pyocyaneus* are not present, local penicillin is used instead of boric acid. Should *B. proteus* or *B. pyocyaneus* be one of the contaminants, the compresses are kept moist with 1 per cent acetic acid until these organisms disappear. Such management of the wound is continued until complete epithelization has occurred.

Replacement of free grafts by a variety of pedicle procedures has been successfully carried out in a considerable number of these patients. It is intended to discuss in a later paper the various aspects of this semifinal phase of the treatment of traumatic osteomyelitic wounds. In the course of replacing the free grafts it has been possible to obtain *en bloc* biopsies of the orig-

inal graft, the underlying bone, and the intervening tissue, the study of which has been the source of considerable interest.

## RESULTS

Patients treated have been young male adults suffering from traumatic osteomyelitis, almost exclusively due to projectile wounds. Traumatic osteomyelitis has been considered to exist whenever there is purulent drainage from a wound which communicates with bone presenting roentgenographic evidence of infection or fracture. Eight weeks after free-skin grafting there is usually complete epithelial covering of the entire saucerized wound surface, the proportion of relatively normal skin to scar epithelium depending largely upon the amount of initial "take." A large group of cases, with varying degrees of bone involvement, have been treated by this method. The results have been almost uniformly beneficial. In only two cases has complete loss of the graft ensued. It has been necessary in only two cases surgically to remove further sequestra for progressive healing to occur. Cases have been under observation for periods as long as one year after skin graft, the average period having been approximately seven months. The cases analyzed below were selected purely on the basis that they most obviously met our criteria for osteomyelitis, and, as a group, were of more than average severity. Surgery upon these cases was carried out by eight different operators. Results were evaluated in 43 patients presenting 45 osteomyelitic wounds upon whom 47 skin grafting procedures were performed. Criteria for evaluation and results were as shown in Table I.

Of the poor results, two occurred on successive grafts in the same wound. One poor result was so classified in a patient with 50 per cent initial "take" from whom the first graft was completely removed and a new graft substituted to accelerate healing. Another poor result was obtained before we learned the necessity of a tensionless fit of the graft to the bed. This case forcefully demonstrated this necessity. Another poor result was obtained where the obviously futile attempt was made to get skin to grow on completely exposed tendon. Another case was classified as poor where a good "take" followed by infection necessitated resection of the graft and further removal of bone deep in the shoulder girdle. In a sixth case, classified as poor, the free graft has served its purpose well, in that an almost completely healed wound with a few small, cleanly granulating spots has resulted. In this case, replacement by full-thickness skin is being carried out to permit subsequent arthrodesis of the knee joint. A seventh case failed because adequate vascularity was not surgically obtainable. The circumstances attending the poor results in the remaining four cases are not clear.

The sole complication was quite severe. Ten days after a shotgun wound of the wrist, simultaneous saucerization and skin grafting were performed. Moulded plaster pressure was employed over the skin grafts. Probably due in some way to this form of pressure, an apparently low grade infection developed between the deep and superficial fascia. The patient ran a markedly septic course beginning ten days after operation. Blood cultures

showed *Staphylococcus aureus hemolyticus*. The response to penicillin was favorable. This form of dressing has been discontinued.

Reports by illustration of two severe cases, each involving the tibia, are presented in Figures 2, 3, and color cuts and in Figures 4 to 7, respectively.

TABLE I

Excellent: 90 per cent or better "take," with progressive healing.
Good. 75 to 90 per cent "take," with progressive healing.
Fair: Less than 75 per cent "take," with progressive healing.
Poor: Less than 40 per cent "take," or regrafting necessary.

On the basis of these criteria, the results in the cases considered were:

Excellent—24 per cent.
Good—28 per cent.
Fair—24 per cent.
Poor—24 per cent.

## SUMMARY AND CONCLUSIONS

There have been occasional reports of the successful application of skin grafting in the treatment of osteomyelitis of hematogenous and of traumatic origin for many years. This procedure has failed to gain wide acceptance. It has been successfully carried out by the technic as described for over two years at an Army General Hospital. This is a safe form of surgical treatment. Beneficial results can be anticipated in the majority of cases, with loss of little more than skin in the failures. The use of skin grafting in traumatic osteomyelitis has failed to receive the general adoption its effectiveness warrants.

The authors wish to acknowledge their indebtedness to the medical officers assigned to the Orthopedic Section, Ashford General Hospital, from its opening to the present time, for use of cases whose surgical care they carried out; to Captain F. B. Hall and Technician Fifth Grade Joseph Jackson for their photography; finally, to Colonel D. C. Elkin, Chief of Surgical Service, for constant encouragement, suggestions, and help.

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# EXPERIENCES WITH 156 PENETRATING WOUNDS OF THE HEAD

MAJOR WILLIAM C. GAYNOR, M.C., A.U.S.
AND
MAJOR JACK GURWITZ, M.C., A.U.S.

THE PURPOSE OF THIS COMMUNICATION is to present experiences with 156 consecutive craniotomies performed for penetrating wounds of the head in a Forward Hospital. Simple lacerations of the scalp, no matter how extensive, are not included in this series. However, they should be treated by the Neurosurgical Service. On five occasions depressed compound fractures, which were not revealed roentgenologically, were found during adequate scalp débridements. Scalp lacerations were treated by wide shaving, thorough cleansing with white soap and water, iodine or metaphen, excision of devitalized tissue, introduction of sulfanilamide powder, and closure with two layers of silk, without drainage. No complications were noted. Lacerations should be sutured only when facilities and personnel are ready to proceed with an intracranial operation.

In this series of 156 operations for penetrating wounds of the skull, the dura was found to be intact in 19 cases, and lacerated or penetrated in the remaining 137.

LOCATION OF ENTRANCE WOUNDS

| | | |
|---|---|---|
| Frontal | | 50 |
| Including frontal sinus | 18 | |
| With orbital injury | 8 | |
| Frontoparietal | | 8 |
| Temporal | | 14 |
| Mastoid | 3 | |
| Parietal | | 59 |
| Bilateral vertex | 4 | |
| Bilateral, two wounds | 1 | |
| Parieto-occipital | | 6 |
| Occipital | | 16 |
| Bilateral gutter | 3 | |
| Sphenoid | | 2 |
| Wound through cheek | 1 | |
| Suboccipital (in foramen magnum, through neck) | | 1 |
| Total | | 156 |

MAJOR VESSEL INVOLVEMENT

| | |
|---|---|
| Middle meningeal artery | 15 |
| Major venous sinuses | 11 |
| Total | 26 |

This series includes 14 civilians injured in combat zones, and as a result of this, the ages vary from one to 65 years; the majority were soldiers in the third and fourth decade of life.

The average time-lag between the time of injury and admission to the hospital was 12 hours, although the patients were seen anywhere from one to 72 hours. Experiences with transportation of these patients confirm obser-

vation of others (Ashcroft of the British Army and, as reported in the ANNALS OF SURGERY, July, 1943, by Colonel R. A. Money and Lt. Colonel T. Y. Nelson) that they, as a group, transport well prior to operation but poorly for four or five days postoperatively. In view of this the operative procedure should not be undertaken unless really adequate neurosurgical facilities are available. However, the opinion expressed by some neurosurgeons that these patients should be transported to a base is not agreed with because this may necessitate a delay in surgery of from 24 to 72 hours, or more. Many of these cases show rapid progression of signs and symptoms, and would not tolerate the delay necessitated by evacuation to a Base. Intracranial wounds have much in common with wounds of other parts of the body. After proper preparation of the patient, the earlier the procedures are undertaken the better the end-results, both as to mortality and return of function. It is readily admitted that many of the cases that would die in transit, are those with very little hope for a good return to a fairly normal existence. However, a few of these cases have produced pleasant surprises. The Forward Evacuation Hospital is the ideal place for this type of surgery, for it presents the most forward site where adequate facilities are available. Neurosurgeons, who have worked with field hospital platoons set up near Clearing Stations, have expressed the opinion that such installations are "no place for neurosurgery." While it is true that Field Hospitals are equipped to do first priority surgery—penetrating wounds of the abdomen and chest, very severe extremity wounds, *etc.*—it is also a fact that, as their facilities are limited, head cases frequently have to wait. Because these patients do stand transportation better before than shortly after operation, and because the Field Hospital moves much more frequently than the Evacuation Hospital it would seem sounder surgical policy to send such cases on to the Evacuation Hospital at once. The absence of a roentgenologist in the Field Hospital is another cogent reason for evacuating head cases to a larger hospital installation before definitive surgery is undertaken.

Upon admission to this hospital the patient is taken to the preoperative tent. Here a complete physical examination is made, and adequate treatment for shock or impending shock is instituted. A thorough neurologic examination is made, with the aid of the neurologist. His opinion is very important, not only to record the evidence of damage, but also as a basis for follow-up study of the patient. When the patient's shock is under control, and not before, roentgenologic studies are made and carefully studied with the roentgenologist. The value of stereoscopic exposures is great. However, many of the patients are unable to cooperate and such films may be impossible to obtain. While still being prepared for operation, the patient is given preoperative medication. This is composed mainly of barbiturates, morphine and atropine or scopolamine. There have been no untoward reactions in the administration of morphine in doses up to 10 mg., and it has been a definite aid in the induction of the anesthesia. In the last 40 cases, penicillin has been administered preoperatively as a routine. Prior to the use of penicillin, sulfa-

diazine was administered intravenously in all cases where operative delay was necessary.

In this series, novocaine infiltration, sodium pentothal and endotracheal ether were employed. Local novocaine was found unsatisfactory because of the psychic trauma, and the inability of the patient to coöperate. In addition, the presence of multiple wounds in 103 cases strongly tipped the scales in favor of general anesthesia. In the first third of the series, sodium pentothal was used in the majority of the cases. Although there were no untoward results, that is not the anesthesia of choice, for the following reasons:

1. The majority of the procedures are lengthy, especially so in patients with multiple wounds.
2. The patients are often in the face-down position and the control of respirations is more difficult.
3. In Lt. Col. Beecher's excellent recent anesthesia report,* sodium pentothal was shown to be more lethal than ether.
4. Patients given sodium pentothal take much longer to react than those who have had ether, making postoperative procedures and observations more difficult.

Ether is not only the safest anesthetic, but the use of an endotracheal tube has obviated the danger of aspiration of blood in procedures involving the face, antrum, and frontal sinuses. This procedure keeps the patient under complete control during the intracranial operation and in the various positions required for the surgical treatment of multiple wounds.

It is obvious that adequate instruments must be on hand if the procedures are to be satisfactory. Front line Ordnance Companies have been most helpful in making some instruments, designed by the authors. These include unusually long, narrow, lighted retractors, a specially designed long, narrow suction tip, to aid in the removal of deeply driven small bone chips, a long seven-inch magnet tip for the removal of metallic foreign bodies, as well as a good scalp retractor. By the use of a padded baseball mask, attached to a steel plate by metal arms, a satisfactory head rest was made.

While the patient is being anesthetized, plasma is started, and at least 500 cc. of whole blood is on hand for use during or after the operation. When the patient is asleep, the scalp is completely shaved, washed, prepared with antiseptics, draped in the usual manner, and then the wound is excised, but the removal of skin is extremely conservative. Adequate exposure is accomplished usually by linear extensions and is guided by roentgenographic findings. With a "tripod incision" poor healing is common, and this incision is undesirable and unnecessary. By carefully undermining the scalp, one can usually close the wounds without difficulty. Only one case in this series demanded a counter incision for closure, and that was due to the extreme loss of tissue. The periosteum having been carefully lifted (for it may be used as a graft) one or more bur holes are made in normal bone adjacent to the damaged area,

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down to intact dura. The destroyed bone is removed by carefully rongeuring around it. Herniated brain tissue is removed by suction or cautery and bleeding vessels controlled by silver clips before further exploration is attempted. Wide removal of bone for proper exposure cannot be overemphasized.

Despite the emphasis in civilian practice on the "elevation" of depressed fractures, only one case was found suitable for elevation. This was a frontoparietal wound from a direct blow of a rifle butt. In most penetrating wounds in combat zones, the involved bone is so comminuted and the fragments so scattered, that elevation and preservation is out of the question. Extradural hemorrhage is usually found in this type of wound, but is not very severe, for the depressed fragments tend to control bleeding. Tears of the middle meningeal artery were encountered in 15 cases, the hemorrhage being controlled by clips, cautery, and in two cases by plugging the foramen spinosum with cotton.

In 19 cases the dura was found to be intact. Even if the color is normal, lack of pulsation is considered a good indication for subdural investigation. Lack of dural pulsation led to opening of the intact dura in 14 cases, and definite subdural pathology was encountered in every case—there were three subdural hydromas and one intracerebral hematoma. The remainder showed either macerated brain or hematoma. The dura was closed after normally pulsating brain was visualized. In the penetrating wounds damaged dural margins are excised very conservatively, the bleeding vessels are controlled, and the opening in the dura is enlarged by radiating or curved linear incisions to provide sufficient exposure of the tract. The tract is débrided by suction under direct vision—with the use of proper size lighted retractors—until firm brain tissue is found. All bone chips must be removed. Since roentgenograms do not show all these, especially minute ones, nothing can take the place of thorough inspection of the tract under direct vision. A useful maneuver here also, is the gentle insertion of the little finger in the tract, for bone fragments, no matter how small, may be noted. The removal of the metallic foreign body is advisable, under direct vision, for that completes the débridement of the tract. Most neurosurgeons agree that missed bone chips provide the ideal nidus for infection and most secondary brain abscesses may be attributed to them. In view of this, cultures of the bone chips were made, with the help of one of the Field Medical Laboratory units, and showed positive bacterial contamination in every case. Although most surgeons advise the removal of metallic foreign bodies, if easily accessible, they maintain that their presence does relatively little harm. Recently, the culturing of these metallic foreign bodies has found them to be covered with a positive bacterial contamination. The long, previously mentioned, magnet has been used successfully in gently removing the foreign body under direct vision, after the tract has been débrided by suction directly to the foreign body. In long tracts, especially where the foreign body has crossed the midline, it has been our policy to débride, by suction, the complete length of the tract. Direct vision should be obtained as far as possible. The use of a soft rubber catheter

in very long tracts is preferable to the rigid suction tip. The long tracts should be débrided cleanly and completely, for the amount of brain damage may be all out of proportion to the size of the wounds. Recovery and return of function has been smoother, quicker, and better when all devitalized tissue is removed.

Where the cerebral ventricles have been involved, the mortality has been high in the past. Radical surgery is still necessary, and has reduced the mortality rate. In five ventricle wounds there were two deaths, and these are in the category of long tract wounds, which in themselves carry a high mortality.

Venous sinuses were involved in 11 cases. The wounds ranged from a small tear to one that was completely divided (the superior sagittal in its posterior third) and necessitated ligation. All the others were patched successfully by muscle stamps.

The incidence of injuries through the frontal sinuses and orbit is surprisingly high—26 cases having been seen, of which eight were orbital. The treatment which has proved completely satisfactory is the radical removal of the mucous membrane and the walls of the sinus, thus obliterating them. All injuries through the orbit were done in conjunction with the ophthalmologist. There were three other cases involving the air sinuses, one of the antrum and two of the mastoids.

In the closure of the wounds, the one factor that supersedes all others is the closure of the dura. After complete hemostasis has been attained in the tract, the problem of local chemotherapy arises. In the first part of the series one to three grams of sulfanilamide were inserted in the tract. Recently, this has been abandoned in favor of penicillin, 7,500 to 20,000 Oxford units injected by hypodermic needle after the dura closure. The dura, in most cases, is so damaged it cannot be closed without resort to a graft. Fascia lata was used in a few cases, especially in the frontal sinus wounds, but this was given up because of the added surgery and the availability of temporal fascia, pericranium or galea, which is very satisfactory. In the last 33 grafts, cadaver dura has been used, with no early untoward results. It is kept on the operating table, and may be immediately cut to the desired size. Being tougher than pericranium, suturing is easier. This method is still on trial and late reports on these cases, which are being anxiously awaited, will prove or disprove the wisdom of this procedure. The dura is preserved by putting it in 10 per cent formalin for 48 hours. After thorough washing in water, it is placed in 70 per cent alcohol, where it may stay indefinitely. Before using it is washed thoroughly in saline.

The scalp is closed in two layers, with one layer in the galea and one in the skin. Three layers are used when the temporal muscles are involved, with the additional layer approximating the muscles. Silk is employed entirely. Drains were employed in two cases in which there was a long time-lag and excessive contamination. The wound is then covered with a vaselined sterile dressing and kept in place with a stockinette hat. Occasionally, when the bone defect is large, a light plaster of paris cap is used.

Better postoperative care is secured by having the patients in one ward, with sufficient personnel, including specially trained and interested nurses and medical corps men. Oxygen by nasal catheter is given routinely to all patients for at least 12 hours. A suction machine is present at all times for any postoperative emergency. The fluid balance is maintained, and 2,500 cc. is usually given daily. Adequate supportive blood and plasma are given when deemed advisable. Sulfadiazine was given intravenously if not tolerated by mouth, but this has been supplanted recently by the use of penicillin, 200,000 Oxford units daily up to a total of 2,000,000 units. Sedation used has been mainly the barbiturates and paraldehyde. Morphine and codeine have been used cautiously in cases complicated by painful additional injuries. Spinal taps have not been done routinely. They are useful in the control of persisting headaches. Sutures are removed from the third to the sixth day depending upon position of wound.

Approximately two-thirds (103) of these patients with penetrating head wounds had other wounds in addition. Forty-six had compound fractures varying from small injuries of the fingers to severe comminution of the humerus or femur. There were three cases with penetrating chest, and two with penetrating abdominal injuries. Fifty-seven had soft-tissue penetrating or perforating wounds. The intracranial procedure may follow the treatment of the other wounds since, with careful observation, the majority of head wounds may "wait" for surgery better than extensive abdominal, chest, or extremity wounds. In certain cases, stage procedures have lowered the mortality. With the other wounds attended to, the patient is observed and prepared with good supportive treatment and liberal use of blood before the intracranial procedure is attempted. Patients with the combination of bad compound extremity wounds and penetrating head wound do uniformly poorly unless this surgery is done in stages—nine such cases were done in two stages, with one death, and five cases done in one stage, with three deaths. The addition of penicillin to our armamentarium should make this two-stage policy safer. In the postoperative care, dual responsibility of the patient with multiple wounds is unsatisfactory, and if it is possible for a general surgeon, trained in neurosurgery, to assume complete control of such a patient, the best results are usually obtained.

In this series, there was no attempt at the selection of cases, except in times of heavy fighting when there might be, and sometimes were, several head cases awaiting operation. At these times, priority was given to the cases which presented the best chance for survival, with return of function. In addition to the 156 operative cases reported, there were 34 other penetrating head wounds seen in our Receiving Tent. Of these, 33 died very promptly, and the other was evacuated to the rear. He had a facial wound of entry with a foreign body of considerable size lying beside the sella turcica. He was in no condition for major operative procedure, even if it were indicated, which is doubtful. He was evacuated of necessity when the hospital moved. One case had both an abdominal and head injury, and

failed to survive the abdominal procedure. The other 32 cases had massive injuries, were in deep shock, and were classed as moribund. Most of these died within six hours after admission. Thirty of these cases were seen in the early days on the Anzio Beachhead, where close proximity to the front made possible the reception of patients who ordinarily would have died before reaching an Evacuation Hospital.

In this series there were 17 deaths, an operative mortality of 10.8 per cent. This includes one case who was sent out during an emergency evacuation, and who was moribund at the time. The follow-up of these patients has been very satisfactory. In the majority of cases the patients remained in our hospital long enough to determine their status fairly well. The neurosurgeons in the rear echelons have been most kind and coöperative, in returning self-addressed V-mail letters sent to the rear with the patients. This informal method has given better results than complicated neurosurgical forms which other surgeons state have given a low percentage of return. There have been follow-up reports by letter of 90 of these cases, and, in addition, 20 others in the base hospitals were seen personally. The operative mortality is influenced by the fact that most of the patients are young and vigorous. In a considerable portion of these postoperative deaths, injuries other than the head injuries were a large factor.

The most serious postoperative complication encountered, resulted from the unfortunate bombing of our hospital, during which a fragmentation bomb landed beside the ward in which the head cases were housed. As a result of bomb fragments, one of the postoperative head cases required a major chest procedure, two required major amputation, and the remaining nine were wounded again. Fortunately all survived the additional injury.

A brief discussion of the patients who died in our hospital following operation follows:

**Case 7.**—A soldier, age 28, was admitted nine hours after a bullet had pierced his right frontoparietal skull. Unconscious and paraphlegic. B. P. 80/0, pulse 120. He was given plasma, 3 units, and whole blood 1,500 cc. Three hours later operation revealed large bursting fractures of the entire vertex, with considerable brain damage in both parietal lobes. Never responded, and died 15 hours postoperatively. This type of case carried a grave prognosis and, during busy periods, more favorable cases should be done first.

**Case 17.**—A soldier, age 24, entered ten hours after being wounded. He had multiple penetrating wounds of the head, chest wall, both arms, both legs, and buttocks. B. P. 80/0, pulse very rapid and weak. Was semicomatose and in severe shock. Had 6 units of plasma and 1,200 cc. of whole blood. Roentgenologic examination showed a comminuted fracture right frontoparietal skull, with indriven bone fragments; comminuted fractures left femur and all bones of left elbow. Metallic foreign bodies in left scapula, chest wall, buttocks, and both thighs. Due to the position of the head wound and his lack of improvement, operation was started because it was felt he had a laceration of the middle meningeal artery. This was found cut; controlled by silver clip and cautery. Craniotomy was completed and remaining wounds were débrided and cared for in the usual fashion. However, signs of early gas infection were found in the wounds of the buttock and left thigh, and despite all antigas and supportive treatment, including 2,000 cc. of whole blood, patient died 72 hours after operation. Penicillin was not used as it

was not available, but probably would not have helped, as autopsy revealed massive gas infection which had already spread into the retroperitoneal recesses.

**Case 24.**—A soldier, age 22, arrived 21 hours after shell fragment had penetrated the right parietal skull. Unconscious, B.P. 60/30 and pulse 150. Plasma 4 units and whole blood 1,000 cc. were given. Roentgenograms revealed a punched-out area in right parietal skull, with three small metallic bodies in the base of the right hemisphere. At operation, tract was thoroughly cleaned as far as, and into, the lateral ventricle, from which two foreign bodies were removed. Despite oxygen, blood, plasma, he died 62 hours postoperatively, never having responded at all. Autopsy showed severe brain damage with the remaining foreign body imbedded in the floor of the ventricle.

**Case 31.**—A soldier, age 21, had had a small penetration of the left frontal skull, with slight damage, and was in excellent condition upon his return to the ward from the operating table. He happened to be one of the early cases on the Anzio Beachhead, just after the hospital had been set up. The nurses were not present during the early part of this invasion, leaving the hospital 50 pair of hands short of help. At this time there were many sick patients on the ward, when a very severe air raid began, and in the excitement the patient was overlooked. He was found dead one hour postoperatively, probably due to aspiration. It was felt that he would have had a complete recovery.

**Case 37.**—A soldier, age 28, entered four hours after being wounded. He had a traumatic amputation of the right leg just below the knee and another shell fragment had penetrated the right frontal skull. B. P. zero, pulse exceedingly rapid and thready. Tourniquet was left in place, and after 6 units of plasma and 1,500 cc. of whole blood the general condition appeared good enough for surgery. Roentgenograms had shown a depressed fracture right frontal area, with bone chips and foreign body driven into the right frontal lobe. Near the completion of the craniotomy his general condition became too poor for further surgery, so a physiologic amputation of the leg by tourniquet was decided. One thousand cubic centimeters of whole blood and 2 units of plasma were given, but the patient died three hours later. Death occurred suddenly and unexpectedly. Postmortem examination failed to show any other cause for death.

**Case 38.**—An unknown British soldier was admitted unconscious, with a right hemiplegia. Pulse 64 and B. P. 120/80. Left pupil was enlarged and fixed. Roentgenograms showed a huge foreign body in floor, or vicinity of, the third ventricle, with a punched-in area to the left of the sagittal suture in frontal region, with bone chips strewn along path of missile. Three units of plasma and 500 cc. of whole blood were given before operation. Patient died 60 hours later, never having regained consciousness. Autopsy showed severe brain damage, with the foreign body in the floor of the third ventricle.

**Case 49.**—A British grenadier, age 28, was admitted unconscious, with a right hemiplegia. Had a bad laceration over the left occipitoparietal scalp, with other penetrating wounds of the right buttock and thigh. B. P. 90/64, and pulse 80. Roentgenograms showed the foreign body in the scalp, but no bone defect was noted. Two units of plasma were given. Pulse began to slow and débridement of scalp was done. Investigation of the scalp revealed a depressed fracture, which was then explored. The dura was intact, but a subdural hematoma was found over the left motor strip, with considerable brain damage. Patient died 24 hours later and postmortem examination failed to reveal any further pathology.

**Case 52.**—A British soldier was brought to the hospital six hours after a 30-caliber bullet had pierced left frontal skull. Unconscious, with a good pulse and B. P. Roentgenograms showed bullet to be in the right parietal area. Three units of plasma and 500 cc. of whole blood were given, and the operation was started six hours after admission. The tract was cleaned by suction as far as the midline, and all bone fragments were removed. Despite supportive treatment patient died 30 hours later, never having recovered consciousness.

**Case 57.**—A German prisoner, unconscious, with spastic paralysis of all extremities. Had penetrating wounds right antrum, right shoulder, and right thigh. Several metallic foreign bodies were seen roentgenologically in the vicinity of the pituitary gland. After 2 units of plasma and 500 cc. of whole blood, the tract was partially cleaned out, through the antrum wound. Twenty-four hours later lumbar puncture revealed a pressure of 400, and when repeated in six hours was found to be 200. Patient died next day, never having regained consciousness. Autopsy revealed the foreign bodies imbedded in the cerebral peduncles, with marked damage of the surrounding brain tissue.

**Case 62.**—The patient, age 24, was injured six hours prior to admission, was unconscious, with a right spastic hemiplegia and a left facial paralysis. Had a wound left parietal area, with a large brain herniation. Pulse 80, B.P. 110/70. Foreign body and bone chips were seen roentgenologically in the left parietal lobe. Six hours later, after 2 units of plasma and 500 cc. whole blood, craniotomy was performed. Condition seemed good postoperatively, and upon arrival at the ward tent, but he stopped breathing, and despite all methods of resuscitation he was pronounced dead.

**Case 65.**—A British grenadier was admitted two hours after having received a penetrating wound of the left frontal skull. He was unconscious, and had a left hemiplegia. B. P. and pulse were good. Roentgenograms showed a comminuted fracture left frontal skull, with metallic foreign body in the right parietal lobe. Three hours later, after plasma and blood, craniotomy was performed. The tract was cleaned as far as the midline, but the brain did not pulsate normally. Investigation was continued but no further pathology was found. Dura was closed. Twelve hours later pulse slowed considerably, respiration faltered, and patient had a severe brain herniation, dying immediately. This case proved the vast importance of having the brain pulsate normally before closing the wound. Since this time a wound was never closed unless the brain did pulsate normally. On one occasion an intracerebral hematoma was found in view of this policy.

**Case 70.**—A Scotch guard, was admitted unconscious, two hours after shell fragment had penetrated the right occiput. He had a spastic hemiplegia on the right. Pulse 80; B. P. 150/80. Roentgenograms showed a comminuted fracture right occipital skull, with a foreign body in left parietal area just beneath the inner table. Six hours after admission, following blood and plasma, craniotomy was performed. The tract was cleaned to the midline and a counter incision was considered. This was impossible because the general condition of the patient became very poor. Patient never responded, and died in 72 hours. Postmortem examination revealed massive brain damage, especially in the left parietal lobe.

**Case 115.**—A soldier, age 23, was comatose and nonresponsive on admission, with a pulse of 72 and B. P. 80/40. He had a penetrating wound of the left temporal skull, with comminuted fracture there, and the foreign body, seen roentgenologically, lay in the posterior portion of the left parietal lobe, probably against the falx. He had a right facial paralysis and a flaccid paralysis of the right arm. After preoperative supportive treatment, craniotomy was performed, and the tract was cleaned as far as the falx. The foreign body was never found and appeared to have slid along the falx. Patient never responded, and despite all supportive measures, including the placing of a large suture in the tongue to prevent its falling back in his throat, he died 65 hours postoperatively, with cardiac failure. Autopsy showed marked brain damage of the left parietal lobe with the foreign body having slid posteriorly along the falx. This death brought an end to a successful series of craniotomies—45 without a death—in the previous 60 days.

**Case 127.**—A soldier, age 32, entered with a large brain herniation in the left parietal area, due to a penetrating wound by a 9-Mm. bullet, and another penetrating wound of the abdomen. Unconscious, with a right hemiplegia. Pulse and B. P. were good. Roentgenograms showed a comminuted fracture left parietal skull, with bullet in the parietal lobe. Celiotomy was performed, and perforations of the small bowel were

closed. The next morning, with additional blood and plasma, craniotomy was performed, and the bone fragments and bullet were removed. Patient never responded, and died 76 hours postoperatively. Autopsy revealed massive brain damage, and a clean abdomen. The second operation may have been undertaken too early, but this man would probably have died anyhow.

**Case 132.**—A soldier, age 29, entered ten hours after penetrating wound left parietal skull by 30-caliber bullet. He was unconscious, with a pulse of 60 and B. P. 160/80. Had a very large brain herniation, right spastic hemiplegia, and pupils were markedly contracted. After blood and plasma, operation was undertaken 21 hours after admission, and revealed large bursting type fractures, with marked brain damage. Dura was damaged in an area 16 x 8 cm. The bone chips and bullet were removed, but patient's condition was considered hopeless. In an emergency evacuation 24 hours later he was sent to the rear. Although no word has been received, it is presumed that he died.

**Case 137.**—A 16-year-old Italian civilian male was semicomatose on admission, with a penetrating wound right parietal skull. He had a very large brain herniation, and a left hemiplegia. Roentgenograms revealed a comminuted fracture left parietal skull, with a group of bone fragments driven deeply to the midline. Pulse and B. P. were good, and after plasma and blood, operation was performed 30 hours after injury. A bone defect, 6 x 8 cm., with a dural defect, 3 x 6 cm., were found. He had a very long tract, all the way to the falx, where the majority of the bone chips were found. On their removal considerable early degeneration was found around them. Despite supportive treatment patient died ten hours postoperatively. Postmortem examination revealed extensive brain damage.

**Case 138.**—A soldier, age 23, was received two hours after a bombing accident, with multiple severe penetrating wounds, in addition to the scalp wound he had penetrating wound of the face, neck, chest and abdominal walls, both legs and both arms. He had a compound comminuted fracture of the right radius in addition to the one of the right parietal skull. All the wounds were considerably contaminated with clay and dirt. B. P. was zero, pulse was very rapid and thready. Fifteen hundred cubic centimeters of whole blood and 3 units of plasma improved his general condition, so all wounds but that of the skull were attended to, with immobilization for the fractured radius. Twenty-four hours later, after 500 cc. whole blood, craniotomy was started, and a depressed fracture, with a subdural hematoma, was found. Patient failed rapidly, and died as the wound was closed. The second-stage procedure was probably attempted too early, and this is probably one of the cases in which the skull procedure could have "waited" until careful observation for at least another 24 hours.

## SUMMARY AND CONCLUSIONS

1. Definitive surgery for penetrating head wounds should be undertaken in the forward Evacuation Hospitals, which are the first installation with proper equipment and personnel for the handling of these cases.

2. Emphasis on early surgery for battle wounds applies strongly to cranial wounds, just as it does to other parts of the body.

3. There is a definite group which would not survive a long time-lag. These cases are best operated upon in a forward Evacuation Hospital.

4. The anesthesia of choice is endotracheal ether.

5. The dura must be closed, and neighboring pericranium or fascia is usually adequate. Preserved cadaver grafts have been useful in certain large defects.

6. Lack of dural pulsation indicates the need for subdural investigation, when intact dura is found beneath bone.

7. The importance of the liberal use of blood cannot be overemphasized.

8. The establishment of a Head Ward, with trained personnel, has lowered our mortality.

9. In patients presenting other severe wounds in addition to the penetrating head wounds, it is often best to undertake surgery in stages.

10. It is far more important to remove indriven bone fragments than metallic fragments. However, a greater effort to remove the latter should be made.

11. There is no indication for the routine use of drains in these cases.

12. Tripod incisions should be avoided.

13. The exact relative importance of penicillin and sulfonamides in the treatment of penetrating wounds of the head is still to be established.

14. Thorough, painstaking and rather radical débridement of damaged brain tissue is essential to a lowering of morbidity and mortality.

ADDENDUM: Since the preparation of this paper, 146 additional craniotomies have been undertaken for penetrating head wounds. There have been 12 deaths. It is too early to draw any additional conclusions.

# EXPERIENCES WITH INJURIES AND DISEASES OF BONE IN WORLD WAR II

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PROGRESS in the treatment of bone injuries and diseases resulting therefrom has been steady ever since World War I, and during the present conflict has accelerated at a rapid pace. During the past 20 years there has been an increasing tendency for this branch of Surgery to be confined to bone specialists and orthopedic surgeons. However, a shortage of trained orthopedists has made it necessary that some of this work again come under the care of the general surgeon, and it is with that care, and from that standpoint, that this communication is concerned.

Ordinarily an Evacuation Hospital would treat only acute bone injuries, but by force of circumstances our hospital for many months has acted as a General Hospital for Chinese troops and has had to supply definitive and final treatment for all types of conditions. Our aim has been to obtain the best results possible by the simplest methods, and in the shortest time.

We have seen a large volume of cases—a certain number of them being recent injuries—but the majority have received primary treatment at some other installation and passed through a second hospital before coming to us. Thus, the number of cases of osteomyelitis constituted a much larger percentage than a complete tabulation of all injuries received in any theater of war would show. While we have had cases of injury to practically every bone in the body—many of them being compounded—we will only discuss the treatment of the more common types.

A word about the condition of our patients is in order. While most of them are young, their general average of health, upon return from the battlefield, is apt to be below par. They tend to be undernourished, anemic, and the majority have chronic malaria and general infestation with worms. We have no direct evidence to show that bones will not heal as quickly in such a patient but we have found that wounds of the soft parts become infected more easily, granulate more slowly, and are much slower to return to normal. A probable deficiency of vitamin C makes operative wounds bleed so freely as to be more than troublesome at times.

As already stated, we have tried to use the simplest methods which will give the best results. In general, we prefer closed to open reductions; skin traction to skeletal traction, and plaster splints and encasements to the complicated metal splints. We have no hesitation in using any of the nonpreferred methods if as good and as rapid results cannot be obtained otherwise. For instance, a badly aligned transverse fracture of the first metatarsal in a colored boy was plated immediately when we were unable to reduce the displacement

by closed methods. Muscle and tissue were found between the ends. We have had to plate seven fractures of the shaft of the femur for the same reason. While we have been fortunate enough to have no infections resulting from our open reductions or use of pins and wires, the fear of such infection is constantly in our mind and we prefer not to subject the patient to that risk.

Most fractures of the clavicle respond to simple treatment—a cruciate splint, holding the shoulders back and leaving the arms free, has, in general, proved satisfactory. They can be returned to duty in three weeks. In three cases where separate slivers of bone threatened to injure the subclavian vessels, these were removed through a small incision. The clavicle is a relatively unessential bone and we have not considered that accurate anatomic reduction was necessary—so have not attempted the wiring operation lately advocated in some clinics. In cases of osteomyelitis the most rapid closure is obtained by removing the whole involved portion. We have seen one case of congenital absence of both clavicles in a soldier who was perfectly able to carry on his duties.

Fractures of the scapula require little treatment beyond strapping and rest of the part. They are much more common in war surgery than in civilian practice. Osteomyelitis may be rather extensive, and in one case required removal of the entire body of the scapula. Fractures of the ribs, where there is no pleural or pulmonary damage, are also simple to care for. Infection may be extensive and tends in some cases to spread rather rapidly. Operation for removal of infected ribs is not simple, and great care must be taken to avoid entering the pleural cavity. This happened in one of our cases, with an eventual fatality.

Fractures of the vertebral bodies are treated by plaster jackets and rest for four months. The rest in the case of our Chinese patients often is highly theoretical, and it is not at all uncommon to find them visiting the nearest bazaar a week or so after their injury. The fact that they seem to recover as rapidly and with no more ill effects than those patients whom we do control, makes us wonder whether this long period of rest is necessary. Fractures of the transverse processes are common and respond quickly to two or three weeks rest either in a light plaster jacket or merely adhesive strapping. This is in marked contrast to most of the cases we have seen in civilian practice—especially compensation cases where the complaint of pain persists for many months.

The "hanging cast" for fractures of the shaft of the humerus has in our hands given excellent results. Even compound fractures respond very well and it is only in fractures of the surgical neck that it is necessary to fix the arm in full abduction, and exert traction to obtain proper realignment of the fragments. Six to eight weeks immobilization in most cases proves sufficient and early treatment with heat and massage helps to restore full motion. In these fractures, as in all fractures, we are much more interested in a good functional result than in the anatomic result. If both results are good, so much the better. Fractures about the elbow, particularly when compounded, may

be especially destructive. Fractures of the olecranon process or the epicondyles should, in general, be treated by open reduction and accurate replacement of the fragment. Early active motion is indicated. When the joint is destroyed, and ankylosis is the unavoidable outcome, an effort is made to have this occur with the arm in about 80 degrees flexion.

A large proportion of the cases of fractures of the bones of the forearm has been due to battle wounds; often with considerable loss of the bone. Many cases of osteomyelitis result which frequently entail further loss of bone. When both bones are equally affected, the quickest result is obtained by resecting the diseased part and wiring the ends together, thus, deliberately shortening the forearm. Surprisingly good function results. In other cases, once the infection has been cleaned up, it is necessary to insert some form of bone graft. Since this is designated an Evacuation Hospital and we, therefore, lack a motor saw, we have used the medullary peg-type of graft, which when accurately inserted and adequately fixed, gives excellent results. Wounds of the hand with damage to the metacarpals and phalanges are very common. A recent article in the Naval Medical Bulletin, by Webster,[1] brings out some interesting methods of treatment. When there is marked infection early amputation of the affected finger or fingers often proves the most conservative procedure in the long run. The loss of two fingers does not preclude the return to duty of the Chinese soldier.

Fractures of the pelvis have been about equally divided between those due to wounds and the simple uncompounded injuries. In only one case has the urethra been torn. These cases were generally treated by placing the patient on a hard-surfaced bed, with Buck's extension on both legs. The sling-type of suspension has not been necessary as a rule. The results have been satisfactory.

As might be expected, we have had relatively few fractures of the neck of the femur. We may have erred on the side of conservatism in not using pins or nails in those cases, yet our results with the use of the Whitman abduction spica have been fairly satisfactory. Most of these cases have been able to return to duty by the end of 18 weeks. Fractures of the shaft of the femur have been mostly of the compounded variety. Several of the simple cases have required plating, as stated earlier. Instead of a spica we have used, in many cases, a three-way splint—first shown to one of us (W.M.W.) by Dr. James M. Hitzrot, of New York City. This consists of a long six-inch-wide plaster splint posteriorly, extending from the tip of the scapula to the end of the toes; a second similar splint applied laterally from the lower ribs to the tip of the lateral malleolus; and a third shorter splint running obliquely across the anterior surface, the proximal end fastened over the anterior superior spine, and the distal end grasping the inner surface of the knee. These splints are easily applied and possess several advantages over a spica: (1) They are much more comfortable. (2) They are easily adjustable—in many cases the patient loses weight and if in a spica there may be some shifting of the fragments. Splints are easily tightened so as to continue to hold the fragments in

good apposition. (3) They are less liable to cause pressure sores and necrosis. With our Chinese patients this is especially important. In one of these cases —although circulation of the toes seemed adequate, and there were no complaints of pressure—when the spica was removed there was found extensive slough of the whole lateral group of muscles of the lower leg. This occurred in a patient with fractures of both femora and one humerus, who was for many days in a very precarious condition, and in a poor state of nutrition, but, nevertheless, we believe it would have been avoided if splints had been used. (4) Two of the splints can be removed so as to apply early massage to the muscles and maintain their tone. One of our operative cases was enabled to return to duty four months after operation by this treatment. Russell traction has proven relatively unsatisfactory in the treatment of these fractures. There has been a lack of sufficient personnel to closely supervise these cases and the Chinese, not understanding what we are attempting to accomplish, are apt to request their friends to remove the weights and traction. In a few cases we have used traction just long enough to align the fragments and then have applied splints.

Fractures of the tibia have, upon occasion, required pins through the os calcis for proper reduction. Compounded wounds, with loss of bone substance and infection, are first treated for their osteomyelitis and as soon as this is cured, are grafted. Here, every effort is made to prevent shortening. Fractures of the tibial plateau running into the joint, with separation, require open fixation. Generally, one or two screws will accomplish the desired result. Early active motion of the joint is indicated though weight-bearing is not allowed for a period of 12 weeks. Infections involving the fibula alone are treated by excision of the entire part involved. All but the lower end of this bone can be removed, with no loss of function.

War wounds of the feet are apt to be particularly disabling. With even a comparatively good result, if any pain remains the soldier is no longer fit for duty. Therefore, in these cases we can afford to take a longer time, be conservative in our treatment, and try and cut the resulting disability and deformity to a minimum.

It is in our treatment of osteomyelitis that perhaps the greatest advances have been made. With the advent of the sulphonamides and penicillin—our experience with the latter has as yet been somewhat limited due to scarcity of the drug—we are able to operate earlier; operate more radically; and, thereby, sooner effect a cure. As has been often stated, these drugs are no substitute for adequate surgery but they are of great assistance in limiting and clearing-up infections. We see none of the terrific systemic reactions which formerly so frequently followed operations for osteomyelitis. As a rule, by six weeks after the original injury we are able to determine whether or not there is infection of the bone. Open unhealed sinuses, extrusion of bone fragments, and long-continued drainage are all indications of such infection. Repeated roentgenograms, for comparative purposes, will help to show if the process is progressing. It must be remembered however that roentgenograms seldom

show the full extent of involved bone, and operation generally reveals a much further-advanced process than was suspected. Our usual procedure is to start sulfathiazole treatment about four days before the contemplated operation and continue it for six or seven days thereafter. The operation must be thorough and complete and all infected bone and dead bone fragments removed. Frequently small shell fragments are found and removed at the same time. The bone is saucerized; lightly packed with vaselined gauze; and an encasement applied. Depending upon the amount of discharge this is not changed

TABLE I

SUMMARY OF BONES INVOLVED, DEGREE OF INJURY, PERIODS OF IMMOBILIZATION AND HOSPITALIZATION, AND INSTANCES OF OSTEOMYELITIS

| Bone Involved: | S—Simple C—Compound | | Average Time of Immobilization | Average Time of Hospitalization | No. of Cases of Osteo. | % of Osteo. |
|---|---|---|---|---|---|---|
| Humerus | S | 23 | 5 weeks | 8 weeks | 22 | 20.3 |
| | C | 108 | 6 weeks | 11 weeks | | |
| Radius | S | 26 | 4 weeks | 6 weeks | 16 | 19.3 |
| | C | 83 | 6 weeks | 9 weeks | | |
| Ulna | S | 20 | 4 weeks | 8 weeks | 19 | 18.6 |
| | C | 102 | 7 weeks | 11 weeks | | |
| Femur | S | 16 | 8 weeks | 11 weeks | 18 | 18.1 |
| | C | 44 | 9 weeks | 14 weeks | | |
| Tibia | S | 39 | 6 weeks | 10 weeks | 32 | 36.4 |
| | C | 88 | 8 weeks | 12 weeks | | |
| Fibula | S | 25 | 6 weeks | 9 weeks | 19 | 31.1 |
| | C | 61 | 6 weeks | 11 weeks | | |
| Scapula | S | 4 | 1 week | 4 weeks | 3 | 11.1 |
| | C | 27 | 4 weeks | 7 weeks | | |
| Clavicle | S | 9 | 3 weeks | 5 weeks | 1 | 5.8 |
| | C | 17 | 3 weeks | 8 weeks | | |
| Ribs | S | 22 | 1 week | 3 weeks | 4 | 16.9 |
| | C | 24 | 2 weeks | 7 weeks | | |
| Phalanges | S | 9 | 2 weeks | 4 weeks | 11 | 22.0 |
| | C | 50 | 6 weeks | 6 weeks | | |
| Metacarpals | S | 4 | 5 weeks | 5 weeks | 6 | 8.6 |
| | C | 69 | 5 weeks | 8 weeks | | |
| Metatarsals | S | 10 | 3 weeks | 7 weeks | 5 | 15.6 |
| | C | 32 | 5 weeks | 8 weeks | | |
| Patella | S | 3 | 1 week | 6 weeks | 1 | 11.1 |
| | C | 9 | 6 weeks | 10 weeks | | |
| Os calcis | S | 2 | 4 weeks | 12 weeks | 6 | 42.8 |
| | C | 14 | 11 weeks | 15 weeks | | |

for from three to six weeks. If the operation has been adequately performed, at this time a clean granulating wound is found. If there has been extensive loss of skin, a split-thickness graft is placed on the granulations as soon as they are level with the surface. In a few cases where there has been extensive loss and the bone ends show only slight infection, this is cleaned out and an immediate bone graft is introduced. In these carefully selected cases this has worked satisfactorily and much time has been saved. How many of these cases will have recurrences and flare-ups of their bone infection, only time can tell. In still other cases when the infection is limited, we have attempted primary closure of the wound. The results in these cases have been excellent, but great care must be used in their selection. In some instances with considerable bone loss a muscle graft has been used to fill in the defect. This was recently done in an extensive involvement of the sacrum, a section of the

gluteus maximus being swung into the cavity left after curettement, with resultant closure by primary union. Since starting this method of treatment, an article by Key[2] has been called to our attention. His experience and results have encouraged us to further extend our efforts in this direction, and we now have a series of over 20 completed cases so treated, with primary union in over 80 per cent. These will be reported in detail by some of our colleagues in the near future.

To date, we have treated 976 patients, with 1,108 fractures. Of these, 260 were simple and 848 compounded. Six per cent of our patients were American and 94 per cent Chinese. We have had 175 cases of osteomyelitis. Two hundred twenty-five patients are still under treatment in the hospital. Of the 751 discharged, 628, or 83 per cent, were able to return to full duty; 50, or 6 per cent, were sent to other installations as permanently unfit for duty; 18, or 2 per cent, were transferred to another hospital for further treatment; 52 patients, or 7 per cent, went absent without leave—a fair presumption that they were well on their way to recovery. There have been three deaths in our series. A short outline of the more important bones involved with periods of immobilization and hospitalization is appended (Table I). The cases not included consist of fractures of the skull, the facial bones, sternum, *etc.*

SUMMARY

1. A brief review of our methods of treatment of fractures in a war zone is presented. These are all directed toward the earliest possible return of the soldier to full duty.

2. A three-way splint used for fractures of the shaft of the femur is described.

3. New advances in the treatment of osteomyelitis are described. These are presented as a suggestion for further trial and experiment and not as a settled policy.

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[1] Webster, George V.; Lieut, M. C., U. S. N. R.: Simple Fractures of the Metacarpal Diaphyses. Naval Medical Bulletin, 42, No. 3, 623–646, 1944.

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# EXPERIENCES WITH SYMPATHECTOMY IN PERIPHERAL LESIONS

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Various lesions manifesting vasospasm of the extremities have been encountered on the Surgical Service of a General Hospital in a Theater of Operations. It has seemed desirable to resect portions of the thoracolumbar sympathetic chain in certain of these lesions. The cases under study cover a period from March, 1944, to September, 1944. It is recognized that the period of observation following operation is entirely too short to draw any positive conclusions, but it is hoped that discussion of the operative indications and early postoperative results will be of interest.

During the past six months, 41 lumbar ganglionectomies have been performed upon 36 patients by members of the surgical staff. An effort has been made to familiarize the younger men on both general surgery and orthopedic surgery with the indications and operative technic. There have been no deaths or complications except for two wound infections, which will be discussed later. Two patients had lumbar ganglionectomies in forward hospitals before admission to our hospital, and they are included in Table II.

The 38 patients having 43 sympathectomies have been divided into five groups for study and discussion. With few exceptions, they all presented evidence of peripheral vasospasm which could be abolished temporarily by preliminary paravertebral injection of procaine hydrochloride.

### Group I—Sympathectomy for Sequelae of "Trench Feet"

There were 23 operations (17 patients) in this group, which is the largest. No attempt will be made to discuss the early pathologic changes which follow exposure of the extremities to dampness and cold. The author had the opportunity of seeing the patients studied by Angelucci and Berson,[1] and agrees, in general, with their conclusions. They found that repeated sympathetic blocks exerted little if any effect on early cases but were beneficial in late cases in which vasospasm was pronounced. As shown in Table I, the interval between exposure and sympathectomy varied between two months and seven months. All patients were originally hospitalized for a time, and many were then returned to either full or limited duty, but because of pain on walking, swelling or persistent vasoconstriction had to be rehospitalized. These patients exhibited the following physical signs in varying degrees:

(a) Cold, clammy feet with or without swelling.
(b) Cyanosis, especially when the feet were dependent.
(c) Diminished or absent peripheral pulsations.
(d) Gangrene of toes or ulceration of skin (nine patients).
(e) Trophic changes of skin and nails.
(f) Excessive sweating from pearly white, papular lesions on feet, with or without superimposed infection.
(g) Tenderness on palpation or pain on weight bearing.

TABLE I

LUMBAR SYMPATHECTOMY FOR SEQUELAE OF TRENCH FEET

| Case No. | Age | Preoperative Findings | Interval Between Injury and Operation | Side Operated | Operative Complications | Operative Results | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 25 | Left foot cold, cyanotic. Absent post tibial. Marked vasospasm. | 5 months | Left | None | Excellent | Patient previously hospitalized twice for trench feet. Preoperative lumbar block showed marked vasospasm. Patient returned to full duty. |
| 8 | 25 | Foot icy, cyanotic. Absent pulses, also compound frac. great toe. | 2 months | Left | Aggravation of old traumatic arthritis | Improved | Patient had pain in left lumbar region postoperatively, which was probably due to traumatic arthritis of spine. Because of bouts of fever, the operative wound reopened. 30 days postoperative but no evidence of infection. |
| 10 | 35 | Foot cold, clammy and cyanotic, with absent pulsations. Vasospasm marked. | 2.5 months | Right | None | Improved | Postoperatively, the foot was hot and dry, and the swelling decreased, but the pre existing pain on walking continued. |
| 12 | 19 | Foot cold, wet & skin shiny and atrophic. | 2.5 months | Right | None | Excellent | A small area of gangrene, skin on the great toe sloughed, but the ulceration healed following operation. Patient returned to duty. |
| 13 | 22 | Feet cold, very dusky, wet, painful & swollen. Left more than right. | 2 months | Left | None | Improved | Patient also had marked vasospasm of fingers following exposure to cold. Pain persisted after sympathectomy. |
| 14 | 21 | Dry gangrene—2 toes. Foot cold clammy and cyanotic. | 4.5 months | Left | None | Improved | Previous hospitalization for trench feet—2 months before this injury. Pain in balls of both feet continued—the vasospasm was relieved. |
| 15 | 26 | Gangrene — 2 toes. Foot cool, skin shiny and atrophic. | 2.5 months | Left | None | Improved | This patient had gangrene of toes on both feet. The left foot was cooler than the right. Healing occurred more rapidly on the left following operation. Foot hot and dry. |
| 16 | 25 | Feet cold, clammy, cyanotic and tender on palpation. | 2.5 months | Left | None | Improved | Pain on walking persisted in both feet though the patient stated that his "left foot felt much better than the right one." |
| 17 | 19 | Hyperhidrosis, severe with whitish lesions on foot, which dripped sweat. | 5.5 months | Left | None | Excellent | Following a period of hospitalization for "acute trench feet" the patient was sent to a replacement depot. Excessive sweating kept skin macerated, and he was unable to do duty. He was returned to duty following bilateral sympathectomy. |
| 18 | 19 | As above. Maceration of both feet. | 4 months | Left | None | Excellent | To duty following bilateral sympathectomy. |
| 19 | 20 | Pearly white lesions on foot, which dripped sweat. | 5 months | Left | None | Left foot 6° F. warmer than right | Hospitalized for 5 months before for trench feet. No duty since because of pain and sweating. Duty one month postoperatively. |
| 20 | 35 | Hyperhidrosis, with maceration. | 7 months | Right | None | Excellent. Rt. foot 5° F. warmer than left. | Two episodes of "acute trench feet." Replacement depot for 5 months. Could not do duty because of sweating and maceration. Sent to duty following operation. |
| 21 | 20 | Hyperhidrosis, with maceration, pain and swelling. | 5.5 months | Left | None | Improved | Left foot 4° to 5° F. warmer than right after operation. Skin lesions healed. Pain on walking persisted. Previously hospitalized for 8 weeks. |

TABLE I (Continued)

LUMBAR SYMPATHECTOMY FOR SEQUELAE OF TRENCH FEET

| Case No. | Age | Preoperative Findings | Interval Between Injury and Operation | Side Operated | Operative Complications | Operative Results | Remarks |
|---|---|---|---|---|---|---|---|
| 22 | 20 | Hyperhidrosis. Severe burning. Pearly - white lesions. | 3.5 months | Left | None | Improved | Left foot 4° F. warmer. Lesions healed promptly, but subjective pain on walking about equal in each foot. |
| 23 | 28 | As above. | 6 months | Left | None | Improved | 3° to 4° F. warmer on left. Pain and slight swelling of both feet persist. |
| 24 | 21 | Bromidrosis, sev. maceration, sev. cold cyanotic feet. | 5.5 months | Left | None | Excellent | Exposure in Nov. & Dec. 1943 (Italy). Conservative treatment for 3 months with astringent solutions & change of socks every few hours did not prevent maceration or fetid odor. |
| 25 | 19 | See Case 18. | 4 months | Right | None | Excellent | 13-day interval between operations. |
| 26 | 19 | See Case 17. | 6 months | Right | None | Excellent | 13-day interval between operations. |
| 28 | 22 | Gangrene skin on dorsum of foot. Cold, wet and cyanotic. | 3.5 months | Right | None | No improvement | There was doubt as to whether sympathectomy was accomplished at operation. Foot was warm and dry for a week but later starch-iodine test showed sweating and temp. was equal to, or less, than normal foot. |
| 29 | 20 | Hyperhidrosis, sev. Multiple ulcers due to maceration. | 4 months | Left | None | Excellent | Patient had hyperhidrosis as truck driver in civilian life, and had to change socks several times a day. Has had repeated ulcers despite medical treatment. |
| 30 | 20 | Same patient as Case 29. | 4 months | Right | None | Excellent | 10-day interval between operations. Patient returned to full duty one month later. |
| 32 | 21 | Same patient as Case 24. | 6 months | Right | None | Excellent | Full duty. Both feet warm, dry and lesions healed. |
| 34 | 20 | Hyperhidrosis, sev. Dermatitis, secondary, sev. Absent D. P. pulse. | 6 months | Left | None | Excellent | Patient treated for 2.5 months in bed, with ointments, penicillin, wet dressing, *etc.*, without benefit. Sympathectomy request by Med. Service. Lesions promptly healed. Temp. right foot 94° F. left 96.8° F. Duty one month postoperative. |

Total—23 operations in this group.

It is difficult to evaluate the results obtained because of the relatively short period of observation after operation. Approximately 50 per cent were returned to duty within a month after sympathectomy. The tactical situation in the theater limited the period of hospitalization and some were returned to the Zone of Interior and thence to duty. Other patients with loss of toes were discharged from the service. In general, lumbar ganglionectomy was most effective in patients exhibiting severe hyperhidrosis, with maceration and secondary infection. Most of these men had not performed any duty for several months and had been repeatedly hospitalized despite strict foot hygiene and frequent changes of socks. The results were less satisfactory in patients who had painful feet, with or without swelling. Following operation the feet became hot, dry and flushed, with full veins and strong arterial pulsations but pain on weight bearing continued. Later observations will indicate

whether pain in the sympathectomized foot will continue as long as on the unoperated side.

The following case history is typical of the late sequelae of trench feet:

**Case 18.**—T. S. H., male, white, age 19, was admitted to this hospital, in May, 1944, from a replacement depot. Patient had had 18 months of infantry duty with a minimal amount of foot trouble. Feet were wet and cold from January 12, 1944, to February 12, 1944. Patient noted burning on February 9, 1944, and was admitted to a hospital February 13, 1944. Both feet were swollen on admission and remained swollen for a month, though graded activity was begun in three weeks. In March, 1944, the patient was sent to a replacement pool and began a program of light physical training. Feet began to sweat profusely, the skin became tender and macerated and burning pain recurred. On admission here, general examination was normal. Hands were dry and there was little evidence of psychosomatic disturbance. Feet were cold and pale but quite wet with whitish, raised patches across plantar aspect of right foot. Arterial pulsations were present but diminished (B. P. 130/80). Paravertebral block resulted in marked flushing and dryness of feet:

The second and third lumbar sympathectic ganglia were removed on the left side and, 13 days later, on the right side. The lesions disappeared within a week and the patient became ambulatory. Starch-iodine tests showed no sweating below midthigh levels. Temperatures taken with clinical thermometers between the second and third toes showed the left foot to be 4° F.–6° F. warmer than the right following the first operation. The patient was discharged to duty four weeks after the second operation.

### GROUP II—ARTERIAL INJURIES

There were ten patients admitted following shell fragment wounds, in which major arteries were injured (Table II). As this series is too small to draw definite conclusions, each case will be elaborated upon in addition to basic data given in Table II.

**Case 2.**—On admission, six days after ligation of vessels in the femoral triangle, there was swelling of the thigh and leg with purplish, splotchy areas on the lower half of the leg and foot but no clear line of demarcation. There was early gangrene of the right second toe, with greenish (yeast) discoloration at the base of the toe on the dorsum of the foot. Sympathectomy was performed in the hopes that later amputation might be undertaken below the knee. The thigh and upper half of the leg became warmer but the foot remained unchanged except that the greenish discoloration had extended well above the ankle in 24 hours. The day following sympathectomy, circular incision through the middle portion of the leg revealed the calf muscles to be pale and friable, with loss of contractility and all veins to be thrombosed. A knee joint disarticulation was then done, and the patient made an uneventful recovery. Microscopic sections from both anterior and posterior muscle groups showed early necrosis of muscle fibers, with shrinking and separation from the sarcolemma. Lumbar blocks, or earlier sympathectomy, might have changed the outcome. Elevation of the leg prior to admission did not increase the chances of limb survival.

**Cases 4, 33, 36** and 37 may be considered together, as they all had ligation of the femoral artery, with survival of the extremity. Each had from one to three lumbar blocks in the first few days. The involved extremities were all much colder, and intermittent claudication occurred on walking. All had lumbar blocks, which showed increased warmth in the extremity prior to sympathectomy, so that vasospasm was present to some degree. Case 37 had claudication after walking 200 yards on level grounds, and three weeks after sympathectomy the patient walked a mile without any cramping.

TABLE II

LUMBAR SYMPATHECTOMY IN ARTERIAL INJURIES

| Case No. | Age | Preoperative Findings | Interval between Injury and Sympathectomy | Side Operated | Operative Complications | Operative Result | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 31 | Femoral ligated P/3 — D/2 leg cold—Gangrene 2nd toe. | 6 days | Right | None | Probably unchanged | Patient had had no lumbar blocks and extremity had been elevated on 4 pillows prior to admission. |
| 4 | 27 | Ligation femoral P/3. Absent pulsations — cold feet & anginal crisis. | 34 days | Left | Mild infection of wound | Marked increase in warmth of leg | The shell fragment wound was infected on admission, and the infection of the operative wound was probably due to retroperitoneal lymphangitis. |
| 7 | 34 | Com'p fracture tibia & fibula. Early gangrene, with icy foot. | 13 days | Right | None | Improved | Foot became warmer following operation but supramalleolar amputation was done ten (10) days later because of gangrene present on admission. |
| 27 | 47 | Ligation popliteal vessels. Cold discolored foot. | 4 days | Right | None | Little change | Gas gangrene developed, necessitating amputation at knee 48 hours later. Extensive thrombosis of leg vessels found on dissection of specimen. |
| 33 | 22 | Ligation femoral D/3 — Cool, pulseless foot. | 30 days | Left | None | Excellent | Left foot was 2° F. warmer than normal side, and patient's walking range greatly increased. |
| 36 | 21 | Ligation of femoral P/3—Cool foot, intermittent claudication. | 71 days | Left | Infection of wound | Excellent | Can walk much farther before cramping occurs. Infection probably due to disturbance of retroperitoneal lymphangitis which followed original shell fragment wound. |
| 37 | 21 | Ligation femoral N/3. Claudication after 200 yards. | 86 days | Left | None | Excellent | Left foot 2° F. to 4° F. warmer than normal foot. Can walk without claudication. |
| 40 | 28 | Ligation popliteal vessels—icy foot, gangrene big toe. Com'p frac. fibula. | 5 days | Left | None | Little change in temp. of foot | Amputation, 3 days later, lower third leg because of fever, preexisting gangrene and necrosis of gastrocnemius and soleus. Sympathectomy probably permitted amputation at a lower level. |
| 41 | 19 | Ligation femoral P/3. 4 "lumbar blocks." Cold, pulseless foot. | 2 days | Left | None | Excellent | Foot suddenly became warm about 40 hours after operation, and remained as warm as normal one. |
| 42 | 20 | Ligation popliteal. Lumbar block 1. Com'p fracture head of fibula. | 1 day | Left | None | Fair | Gangrene of tips of two toes remained unchanged and foot was warm. Lower leg amp. was done 72 days later because of chronic sepsis from tarsal and ankle wound and foot drop. |

Total: Ten operations.

Infection in the extraperitoneal incision developed in two of this group, and were the only postoperative complications in the series of 43 operations. These patients all had large thigh wounds and it was felt that disturbance of the retroperitoneal lymphatics at the time of sympathectomy was responsible for the postoperative infection. Both wounds healed after a short period of drainage, without disruption or subsequent herniation.

Case 7 is the only one in the group in which there is no mention of arterial injury. This patient had fractures of both bones of the lower third of the leg, with a cold foot. He had daily paravertebral blocks before ad-

mission, but the leg was kept elevated on "four blankets." There was early mummification of the toes, with absent pulsations on admission. Amputation was required ten days later because of gangrene on the plantar surface. Dissection of the specimen showed all vessels to be thrombosed in the foot.

Cases 27, 40 and 42 all had ligation of the popliteal vessels, and ultimately all required amputation, though for different reasons. Case 27 had had an extensive posterior fasciotomy of the leg and lower half of the thigh and ligation of the popliteal vessels two days prior to admission for perforating wound of the lower thigh and leg. On admission, the patient was found to have a total plasma protein value of 5.6, hematocrit of 22, and hemoglobin of 7.6 Gm. Penicillin 25,000 units every three hours was begun, and he received 1,000 cc. of whole blood on the first and third day after admission here. The foot was cold, bluish and pulseless, but the lower leg became warmer following daily paravertebral blocks. On the fourth day after injury sympathectomy was performed. Forty-eight hours later there was a sharp rise in temperature to 103.8° F., and examination of the leg at this time showed the posterior muscles to be almost purplish in color with crepitation in the muscle bundles and fascial planes. A low thigh amputation was performed because of the extensive necrosis and the clinical diagnosis of gas gangrene. Examination of the specimen showed the vessels to be thrombosed.

Case 40 had two lumbar blocks before admission, and gangrene of skin of 5th toe. Immediately following sympathectomy the original leg wounds were extended and nonviable portions of anterial tibial and gastrocnemius muscles were excised. Three days later a midleg amputation was performed. It was felt that sympathectomy permitted a below the knee amputation. Case 42 had ligation of the popliteal vessels 24 hours after being wounded, and eight hours later had sympathectomy. Gangrene of the tips of two toes developed, but the foot was warm even though there were no peripheral pulsations. Patient had several perforating wounds of the foot and ankle which continued to drain pus. He also had foot drop due to peroneal nerve injury, and marked pes cavus. Amputation through the lower leg was performed 73 days after injury because of the chronic sepsis of tarsal bones and foot drop. In Case 41 the common femoral vessels were ligated and divided just below Poupart's ligament, and lumbar blocks given twice daily. The foot and leg remained cold, however, and the 2nd, 3rd and 4th lumbar ganglia were resected 48 hours later in a Forward Hospital. There was little change for 48 hours, at which time the foot became as warm as its mate and remained so.

In three of the five patients requiring amputation, sympathectomy was performed at too late a date to be effective—6, 13 and 5 days, respectively. It is believed that following damage to the main artery of an extremity immediate "lumbar blocks" should be done, and if there is any question as to viability of the extremity, early sympathectomy should be performed.

The results of sympathectomy in the "late" cases, with claudication and cold, wet feet, have been most satisfactory.

### GROUP III—POSTTRAUMATIC VASOSPASM

There were six patients who had marked posttraumatic vasospasm of an extremity, with edema. Five had shell fragment wounds, and the other had had extensive second-degree burns. This patient, and one other, also had had thrombophlebitis (Table III). The early results in all six patients

TABLE III

SYMPATHECTOMY IN POSTTRAUMATIC VASOSPASTIC LESIONS

| Case No. | Age | Preoperative Findings | Interval Between Injury and Operation | Side Operated | Operative Complications | Operative Results | Remarks |
|---|---|---|---|---|---|---|---|
| 6 | 28 | Shell fragment wds. of rt. thigh and leg. Foot cold, cyanotic, with pulsations. | 1.5 months | Right | None | Improved | Original operative note stated "that the posttibial artery was in spasm." No pulsations were felt except after lumbar blocks. Patient had 7 blocks in all. Marked improvement following ganglionectomy. |
| 11 | 35 | Com'p fractures of fibula & 4th & 5th toes. Foot cold, cyanotic & swollen. | 3 months | Left | None | Improved | Patient had been in foxhole for 5 days (Jan. '44) with wet, cold feet prior to being wounded. Marked decrease in pain and swelling postoperatively. Foot warm and flushed and 2.4° F. warmer than right 1 month postoperatively. |
| 35 | 30 | Com'p frac. 2nd metatarsal. Foot cold, dusky & wet. | 2.5 months | Left | None | Excellent | Pulsations absent before operation, very strong afterwards. Patient had had no improvement with physiotherapy. Left foot 4° to 5° F. warmer than right. |
| 38 | 26 | 2nd-degree burns right leg. Recurrent episodes of swelling. Foot cold and wet. | 20 months | Right | None | Improved | Patient thought to have recurrent thrombophlebitis, with chronic edema and vasospasm of foot following gasoline burn. Marked decrease in edema and increase in temp. of foot after ganglionectomy. Final result uncertain. |
| 39 | 26 | Perf. wound midthigh. Thrombophlebitis. Cool, dusky foot. | 3.5 months | Left | None | Improved | Preoperative lumbar blocks showed large element of vasospasm which may have resulted from the perforating thigh wounds instead of following the thrombophlebitis. Definite improvement after sympathectomy. |
| 43 | 21 | Perforating wound foot. Frac. 1st metatarsal. Foot very cold, cyanotic, swollen, painful. | 3 months | Right | None | Improved | Foot warm, flushed and dry. Pain and swelling much less. Final result uncertain. |

have been good. The edema definitely decreased in each instance and the foot became warm and dry instead of cold, cyanotic and wet.

### GROUP IV—OBLITERATIVE VASCULAR DISEASE

There was one patient, a male, age 28, who was diagnosed as having early, obliterative vascular disease (Table IV). While training in Ireland this patient took pride in keeping up with his company on forced marches but near the close of the Tunisian campaign he began to have cramps in the calves of his legs after a mile or so. Examination revealed B. P. 150/80 on

repeated checks but no palpable sclerosis. The dorsalis pedis artery on the right was never palpable except after a block. The feet were cool and moist but following paravertebral blocks became quite hot and dry. Following staged operations patient was discharged to lighter duty. It has been pointed out by many observers that there is usually a certain amount of vasospasm along with the organic obstruction and that it is important to remove this factor.

TABLE IV

SYMPATHECTOMY IN OBLITERATIVE VASCULAR DISEASE

| Case No. | Age | Preoperative Findings | Duration of Symptoms | Side Operated | Operative Complications | Operative Results | Remarks |
|---|---|---|---|---|---|---|---|
| 3 | 28 | Early Buerger's disease. Absent. D.P. pulsation, foot cool | 14 months | Right | None | Excellent | B.P. 150/80. Retinal vessels normal. Arteries not palpably sclerosed. After training in Ireland patient began to have claudication on marches in Tunisia. Dampness and cold made condition worse. Preoperative blocks showed marked increase in temperature and arterial pulsations, flushing and filling of veins. Patient sent to limited duty. |
| 5 | 28 | Same case as above. | 14 months | Left | None | Excellent | 14-day interval between operations |

GROUP V—CAUSALGIA

There were two patients subjected to sympathectomy for severe causalgia (Table V). One of them obtained marked relief of the burning pain (Case 9), and there was moderate improvement in the other patient. The first patient

TABLE V

SYMPATHECTOMY IN CAUSALGIA OF THE LOWER EXTREMITY

| Case No. | Age | Preoperative Findings | Duration of Symptoms | Side Operated | Operative Complications | Operative Results | Remarks |
|---|---|---|---|---|---|---|---|
| 9 | 35 | Penetrating wound right buttock. Severe burning pain in foot. Trophic changes. | 2.5 months | Right | None | Excellent | Sciatic neurolysis gave no relief from burning and hyperesthesia. Repeated paravertebral blocks gave temporary relief. Marked relief following preganglionic sympathectomy. |
| 31 | 36 | Penetrating wound lower leg. Severe pain in ball of foot. Foot cold and swollen. | 1.5 months | Left | None | Improved | Marked decrease in swelling but little improvement in pain. Patient has old hallux valgus and some metatarsalgia of that foot. Foot warm and dry. |

received a penetrating wound of the right buttock January 26, 1944. The wound was not débrided, and patient was admitted to this hospital five days later with a one-centimeter wound of the superior medial quadrant. There was hypesthesia of the plantar surface of the foot and severe burning pain in the foot which was made worse by slight weight bearing. On March 16, 1944, the sciatic nerve was explored from the sciatic notch to below the inferior border of the gluteus maximus. The nerve was not lacerated or involved

in scar tissue. The pain and sensation of the foot "being afire" continued. Paravertebral blocks gave immediate relief for six to eight hours. Following sympathectomy the patient had only "slight burning in the instep."

The second patient had a cold, swollen, painful foot following a penetrating wound of the lower leg. He complained of burning pain in the ball of the foot. The edema and burning were both improved and the patient was able to discard his crutches. Considering the large number of extremity wounds encountered there have been surprisingly few instances of causalgia.

### EXTRAPERITONEAL LUMBAR SYMPATHECTOMY

All operations were performed through muscle-splitting extraperitoneal incisions. The absence of a tilting table and movable kidney rest lead us to use the anterior incision advocated by Pearl[2] in 1936, rather than the lumbar approach described by White and Smithwick,[3] which we used in our first 14 cases. Spinal anesthesia has been used in the majority of the operations.

In all except a few instances, preganglionic sympathectomy limited to the second and third lumbar ganglia was done, as suggested by White and Smithwick.[3] In the few exceptions, the fourth lumbar ganglia was also removed. The position of the sympathetic trunk was found to be quite constant and could usually be felt with the finger and, thus, more readily isolated. Considerable variation in the size of the trunk and ganglia was encountered. Generally, large ganglia were found to have small trunks. The number and direction of the rami made identification of individual ganglia fairly accurate. Fusion of the second and third lumbar ganglia was found in one instance. In the limited period of observation after operation, we have repeatedly found the denervated limb to be warmer and completely free of sweating four to six weeks later, as determined by the starch-iodine test. Sweating was absent from the midthigh level downward. Rough temperature comparisons were made by placing clinical thermometers between the second and third toes of each foot for five minutes. Further experience may indicate that the fourth lumbar ganglia should be excised in addition to the second and third.

Patients are allowed out of bed within a week, and no complications were noted except in the two infections mentioned earlier. When both extremities were denervated the second operation was performed about ten days after the first.

### CONCLUSIONS

1. Severe hyperhidrosis is a late sequelae of many cases of trench feet. Maceration of the skin and secondary infection may continue for long periods despite careful treatment. Preganglionic sympathectomy has given excellent results in several such cases. Marked vasospasm, with minimal sweating and gangrene, with ulceration, may follow trench feet, and both conditions benefited by sympathectomy. These patients should be carefully selected for operation after a long period of preoperative study. Continued pain following trench feet is not likely to be relieved by operation.

2. Early sympathectomy seems indicated in traumatic injuries to the major arteries of an extremity, especially the popliteal artery. It may be limb-saving in some instances, and frequently will permit amputation at a lower level. It is of marked benefit to those patients with intermittent claudication in the involved leg following arterial ligation and should be performed at an early date before fibrosis and trophic changes occur.

3. Marked vasospasm following injury to the leg or foot, demonstrated by paravertebral blocks, will be improved by sympathectomy. The edema does not always disappear following operation but with the increased use of the foot it is always less than before. Our experiences with denervation for causalgia are too limited for comment, but relief was obtained in two patients.

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# RESURFACING OF DORSUM OF THE HAND FOLLOWING BURNS

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AND

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THE PURPOSE of this paper is to describe a technic for resurfacing the dorsum of the hand following injury to the original skin by burns. The method as originally devised has been very little altered, and has been applied to a very large series of cases in both civilian life and in the Services.

In one series of simultaneously incurred burns alone, the dorsi of 37 hands were grafted. This latter group was from the Knights of Columbus fire in St. John's, Newfoundland. Only three hands had less than a 100 per cent take, in spite of the fact that the majority of the recipient areas were contaminated, granulating surfaces.

Depending upon the depth of skin destruction, the hands present a lesion of one of the following varieties:

(a) A surface covered with easily traumatized scar epithelium, or patches of scar epithelium with intervening areas of more or less normal skin (Fig. 1).

(b) A surface covered with "burn keloid" (Fig. 2). By this is meant a lesion which follows burns, particularly deep second-degree burns. This comprises a thin epidermis which overlies a thick fibrous tissue layer consisting mainly of coarse, collagenous bundles. In this layer, epithelial elements, particularly of sebaceous and sudoriferous glands, are encapsulated (Figs. 3 and 4).

(c) Large granulating areas (Fig. 5).

(d) Large granulating areas with exposed tendons and open joints (Fig. 6).

The aims of the resurfacing procedure in all these types of cases are the same, namely, to restore the hand as completely as possible to its original functional activity; to provide a resilient surface which will withstand the ordinary trauma to which the hand is normally subjected; and to furnish a good cosmetic result.

The functional activities most adversely affected following this type of injury are flexion of the wrist, metacarpophalangeal and interphalangeal joints, and abduction of the fingers and thumb. This loss of flexion is due to superficial scar contracture and structural joint changes. The loss of abduction is due principally to interdigital webbing. It should be appreciated that even in superficial burns the structural joint changes are more serious as a cause of limitation of motion, particularly of the metacarpophalangeal and interphalangeal joints, than superficial scar contracture. This is because these joints are so close to the skin surface that any severe inflammatory process, such as that concomitant with burns, affects also the joint struc-

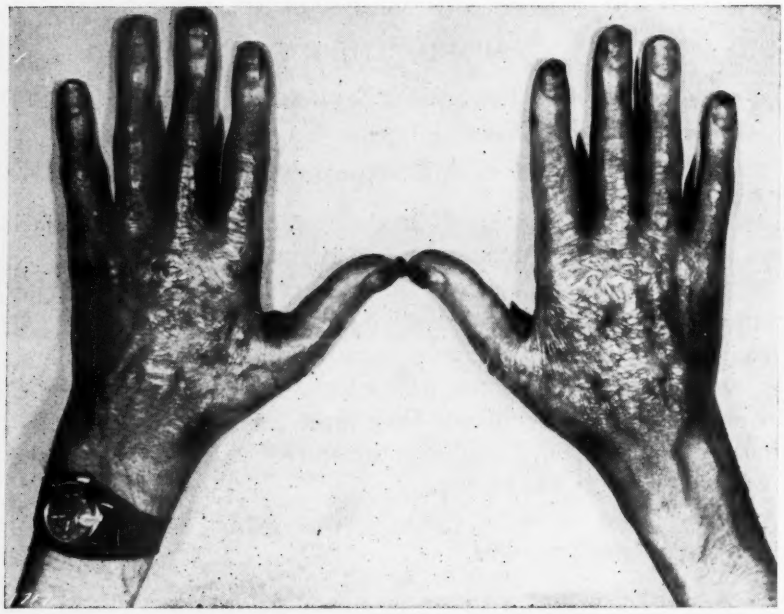

FIG. 1.—Surface covered with easily traumatized scar epithelium.

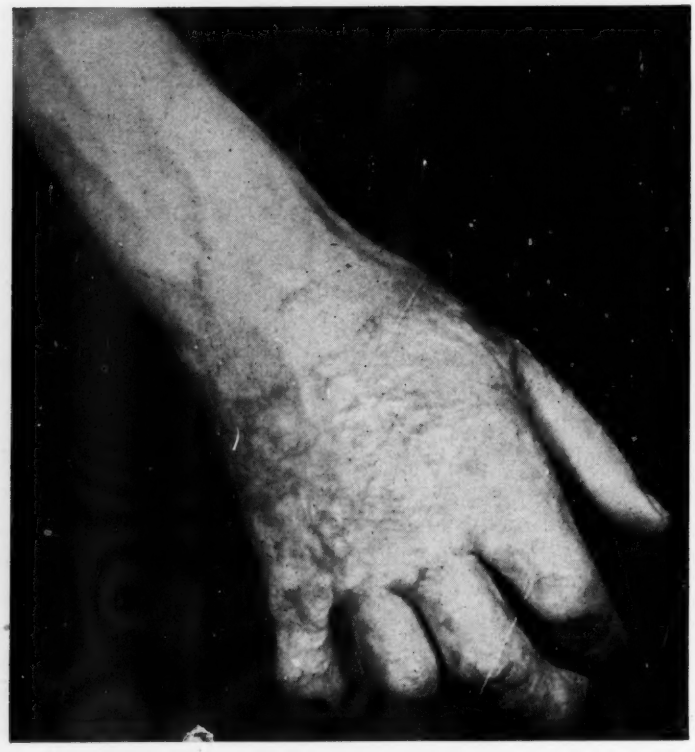

FIG. 2.—Burn keloid.

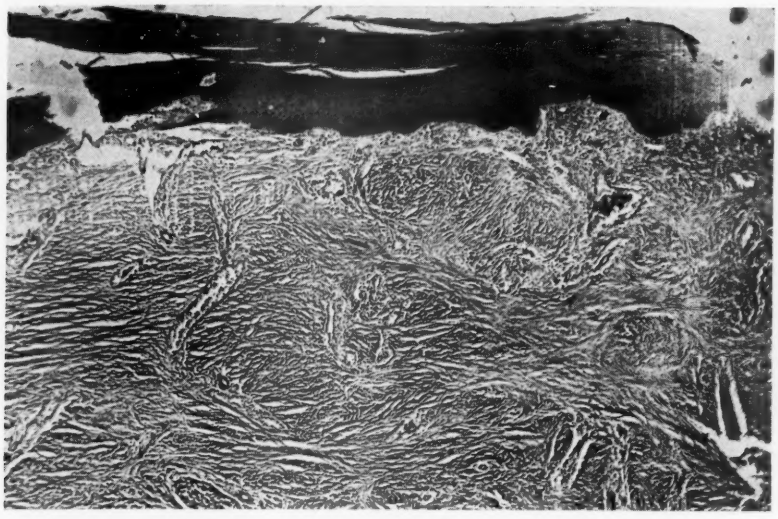

FIG. 3.—"Burn keloid" photomicrograph showing encapsulated groups of sebaceous and sudoriferous glands.

FIG. 4.—"Burn keloid" photomicrograph (high power).

tures. In deep burns the tendons and joint capsules may be exposed after sloughing of the skin or they may even be destroyed so that the joints are open. In some cases, however, the stiffness is due simply to *prolonged* fixation. This does not take place, in the opinion of the writers, with fixation of the fingers for comparatively short periods (*i. e.,* two or three weeks) in cases where the joint structures are not destroyed. It is considered that immobilization in the early stages of the acute lesion is beneficial.

By reason of tendon and joint capsule destruction, extensive joint stiffness and occasionally bony ankylosis result unless resurfacing is performed quickly followed by tendon grafting to restore the motor power to the joints.

FIG. 5.—Granulating surface.

The three aims of any resurfacing procedures can, for the most part, be accomplished by the use of free grafts of .016 or .020 inches in thickness. These grafts will always give an excellent wearing surface and a good cosmetic result. In most cases, this type of graft will also satisfactorily restore the hand to good functional activity. Only occasionally will the use of pedicle grafts be necessary.

The preoperative preparation and the operative technic vary, depending upon the type of surface presenting for repair. When there is no open wound (*i. e.,* when the surface is covered with "scar epithelium" or "burn keloid"), the preoperative preparation is essentially that of any clean surgical procedure. When a granulating surface is present, it is dressed with electrolytic hypochlorite. One part of this solution to 20 parts of water consti-

tutes an isotomic solution. An hypertonic solution (1:8–1:12) is customarily employed. In this strength, for a relatively short period (three to four days), the precautionary measure of protecting the surrounding skin with vaseline is unnecessary. Moreover, it is unnecessary, and indeed inadvisable, to change this solution to saline on the last preoperative day, since it is in no way inimical to the take of the graft. The frequency with which these dressings are changed depends upon the amount of discharge or slough. They should, however, always be kept moist. In open wounds, where there

FIG. 6.—Granulating surface with exposed tendons and open joints.

is concern about the cleanliness of the granulating surface, the patient is put on full therapeutic doses of sulfathiazole two days preoperatively as a prophylactic measure. This is to ensure an effective blood level at the time of the operation. This chemotherapy is continued for 72 hours postoperatively. If vomiting is present during the immediate postoperative period, the blood level is maintained by the administration of sodium sulfathiazole intravenously.

The operation is performed under general anesthesia, with the patient lying in the prone position. Since the majority of these lesions are bilateral, two operating teams work simultaneously (Fig. 7). The evening before operation the finger nails are cut, cleaned and scrubbed meticulously.

At operation, in clean cases, the hand is scrubbed with soap and water,

using a soft brush. This is sluiced-off with saline, dried, and followed with the customary antiseptic preparation. In cases presenting granulating areas, the skin surrounding the granulations is prepared as above, but the granulating area itself is merely sluiced-off with physiologic saline.

Just prior to draping the patient, a pneumatic tourniquet about the upper arm is blown up to 250 mm. to insure a bloodless field.

FIG. 7.—Two operating teams resurfacing two hands simultaneously.

The granulating surface is cauterized with 60% silver nitrate, applied on an applicator. The eschar which results, together with the peripheral zone of scar epithelium, is undercut and excised in one piece, using a large scalpel blade with a sawing motion, and taking care not to "buttonhole" the eschar.

In clean cases, the scar epithelium can be "peeled off" leaving all the dorsal veins and nerves intact if care is taken to find the correct line of cleavage at the beginning (Fig. 8). Any large bleeders (and there should be extremely few) are ligated with ooooo plain catgut ties.

Skin is removed with the Padgett-Hope dermatome (by preference from the back) and the large single sheets are modelled to the defect. When the entire breadth of the hand, including the thumb, is involved, two sheets are sewn together, with the suture line staggered to avoid a straight linear scar, which will contract. This graft is sewn on with a running suture of silk. The subsequent development of interdigital webbing is prevented by

FIG. 8.—"Peeling" off scar epithelium.

cutting the graft as shown in Figures 9 and 10. This places a maximum of tissue in the interdigital clefts, and places all the suture lines at right angles to the direction taken by the interdigital scar, which causes webbing. The grafts are not punctured, except in rare instances when the hemostasis has not been entirely satisfactory.

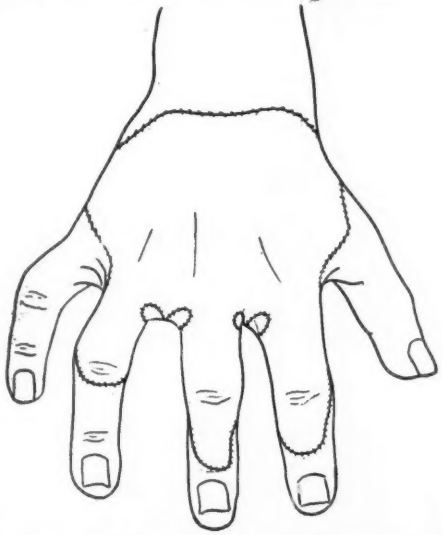

FIG. 9.—Cutting of graft in interdigital spaces to avoid subsequent webbing.

In clean cases, the hand is then dressed with long strips of gauze soaked in saline. In the potentially contaminated cases the gauze is soaked with liquid paraffin and one in ten sodium hypochlorite solution. These strips are carefully molded into the interdigital clefts and then continued beyond the tips of the fingers into the palm of the hand. These strips are of such a width that the fingers are individualized, but nothing is packed down into the interdigital clefts (Fig. 11). While this dressing is being applied, and throughout the subsequent dressings, the wrist, metacarpophalangeal and interphalangeal joints are all held in approximately full flexion.

The palm is filled with fluffed gauze. The entire hand is then covered

FIG. 10.—Cutting of graft in interdigital spaces to avoid subsequent webbing.

FIG. 11.—Individualizing finger with first layer of dressing.

FIG. 12.—Dressing completed.

with two thicknesses of dressing pads, the deep layer wet and the outer layer dry. The entire hand, forearm and distal half of the upper arm over the flexed elbow is then wrapped in a bias-cut flannelette bandage. This ensures light, even pressure. A light plaster of paris encasement is applied over this, completely enclosing the hand, and when this is firm, and not until then, the tourniquet is removed (Fig. 12).

The dressing is left untouched for 10 to 14 days, at which time it is removed and the stitches are taken out. After this the patient begins active finger exercises and massages the graft very gently with lanolin or cocoa butter.

It is noteworthy that these dressings are almost invariably completely dry when they are removed. Only when the dressings have been unevenly applied are there any superficial blebs, and only then are any subsequent dressings necessary.

It has been found that with the successful application of the above technic the indications for the use of pedicle flaps is steadily decreasing. They are now used only rarely.

One remaining indication for the use of pedicle grafts is in cases requiring free tendon grafts. Even in this group of cases there is one patient in whom two extensor expansions have been reconstructed on two fingers under dermatome grafts, and the remaining fingers are in the process of being similarly done.

By the use of this technic, a freely mobile, elastic surface can be produced. It is durable and does not break down. Full usefulness can be restored to all hands in which there is not irreparable joint damage.

The cosmetic result should be such that, after the elapse of about a year, it should be very difficult to discern the extent of the graft.

SUMMARY

A technic for split-thickness grafting of the dorsum of the hands is presented.

By this method full restoration of the usefulness of the hand can be achieved unless there is irreparable joint damage.

A freely mobile, elastic and durable surface is restored.

The cosmetic result is excellent. It is, in the authors' hands, much superior to cases in which pedicle grafts are resorted to.

The indications for the use of pedicle grafts are steadily decreasing. They are employed on surfaces where the extensive replacement of tendons must subsequently be performed.

The use of pedicles is, of course, still indicated where a layer of fat is needed to fill out defects and for protection of important deep structures. In most instances, thick split-grafts or free full-thickness grafts have been used to resurface the palm or parts of the palm, and they have provided a resilient surface which has stood up to the trauma associated with manual labor.

# CHOLECYSTOGASTRODUODENOCUTANEOUS BILIARY FISTULA

CASE REPORT

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EXTERNAL BILIARY FISTULAE are not uncommon but internal biliary fistulae are seen only occasionally and the correct preoperative diagnosis is seldom made. We wish to report an unusual case in which there were features of both internal and external biliary fistulae. In this case, there was no difficulty in observing the drainage of bile to the outside, but only surgical exploration revealed the surprising and unique feature of a concomitant cholecystogastroduodenal fistula. Partial gastrectomy, partial duodenectomy and cholecystectomy were performed, and a good result was obtained. The common bile duct was explored and drained.

Bernhard[2, 3] reported a series of 6,263 cases in which the biliary tract was explored. A biliary fistula was found in 109, or 2 per cent, of these cases. The gallbladder always was involved; the fistula was situated between it and the duodenum in 56 cases, between it and the colon in 36 cases, between it and the stomach in 12 cases, and there were multiple fistulous tracts in five cases. The causes of such fistulae are few. Usually, a stone, or stones, enter the intestinal tract by erosion of the mucosa and wall of the gallbladder and finally are passed, or actually cause intestinal obstruction, in a small percentage of cases. Varying degrees of inflammatory reaction necessarily accompany the ulceration, and in some instances, as in the case which we shall report, frank abscess of either the wall of the gallbladder or intestine is encountered. Stones large enough to cause such ulceration and obstruction never pass the full length of the common bile duct (Wakeley and Willway[7]), but erode through the wall of the gallbladder or bile duct. Rarely, a happy termination to a postoperative stricture of the common bile duct is occasioned by the spontaneous formation of an internal biliary fistula. The passage of the stones usually results in a short fistulous tract, but sometimes there is a direct opening between one element of the biliary tract and the stomach or intestine. Relatively few such cases (internal fistula by stone erosion) have been recorded in the literature.

The causes of external biliary fistula are well known. Balfour and Ross[1] reviewed 166 cases of biliary fistula observed at the Mayo Clinic and found that gallstones and their complications were primarily the cause of the condition in 85 per cent of cases. Since, in the case which we shall report, the

* Since this paper was written the authors have entered the armed services. Doctor Gray is now Captain, M.C., U.S.N.R., and Doctor Sharpe is now Captain, M.C., A.U.S.

surgical procedure was dictated by the possibility of ensuing obstruction at the outlet of the stomach if the mass of stones were left in the pyloric wall, and because of the indeterminate nature of the lesion, the literature concerning this phase of the problem was reviewed. The frequency of intestinal obstruction caused by gallstones varies widely. Vick[6] reported that such obstruction occurred in 47 (1.3 per cent) of 3,625 cases of gallstones, Osler[5]

FIG. 1.—Photograph of the surgical specimen showing the internal surface of the resected portion of the stomach with large gallstone lodged in the wall at the gastroduodenal juncture.

said that it occurred in 23 (7.8 per cent) of 295 cases, and McQueeney[4] said that it occurred in 149 (2 per cent) of 7,232 cases. The true diagnosis is rarely made; the patients are hospitalized late, and surgical intervention is instituted still later. McQueeney reported that the mortality rate in cases in which operation is performed for relief of such obstruction is about 50 per cent, usually because of the delay.

The treatment of internal biliary fistulae depends entirely on the findings in the individual case. The stones should be removed if possible. The fistula should be excised and the opening in the stomach or intestine should be closed. The gallbladder should be removed and the common bile duct

should be drained if there is any doubt as to its patency. Patency of the common bile duct should not be assumed in the absence of a history of jaundice, for the internal biliary fistula may have permitted adequate biliary flow in spite of the presence of stones in, or cicatricial narrowing of, the common bile duct. The danger of ascending infection, recurrent cholangitis, and hepatitis occurring in those cases in which spontaneous internal biliary fistula is not treated surgically has probably been exaggerated, for the most common type of internal biliary fistula involves the gallbladder and direct communication with the biliary tree is interrupted through the tortuous cystic duct and valves of Heister.

**Case Report.**—A blacksmith, age 58, came to the Mayo Clinic, February 10, 1941, because of an external biliary fistula which had been present for ten months. He had had pain and jaundice for the past ten days. Dyspepsia and pyrosis had been present for several years. About ten months previously, he had been operated upon for cholecystitis and cholelithiasis. There had been no previous jaundice. The operation had disclosed many stones in the gallbladder and an abscess which involved the wall of the gallbladder. The gallbladder had not been removed and the common bile duct had not been explored. Cholecystostomy had been performed and the stones had been removed. The postoperative course had not been abnormal except for the fact that drainage of bile had been profuse for the first two weeks. At the end of this time, the drain had been removed. A biliary fistula had occurred and bile-stained purulent material had been drained from the fistula. On several occasions, the patient had passed one or more stones. He had been able to work all summer as a blacksmith. His appetite had been good and his weight had remained constant.

About ten days before he came to the clinic, he had had an attack of epigastric pain, which had extended to his back and had lasted six hours. Jaundice had developed one to two hours after the onset of the pain, and at least one stool had been clay colored. The jaundice had deepened rapidly and had been most pronounced on the following day. Nausea and vomiting had been severe. He had had some fever but had not had any chills. The drainage of bile had been very profuse during the first few days after the attack; then it had ceased suddenly.

The patient was well-developed and well-nourished. The skin and sclerae had a mild icteric tint. Examination of the abdomen revealed a poorly-healed scar in the upper part of the right rectus muscle. In the upper third of the scar there were two or more granulomatous regions which had the appearance of recently healed sinus tracts. This portion of the scar was slightly tender. No mass was present and there was no drainage.

Examination of the blood did not reveal any abnormality. Uranalysis revealed pyuria, Grade 1, on the basis of 1 to 4, a flocculation test for syphilis was negative. The prothrombin time (Quick method) was normal. The van den Bergh reaction was direct, and the value for bilirubin was 1.3 mg. per 100 cc. of serum. It was thought that the patient probably was suffering from cholelithiasis, choledocholithiasis, or both of these conditions.

Operation was performed February 14, 1941. A large number of adhesions were found in the right upper quadrant of the abdomen. The gallbladder was chronically inflamed and contained several small stones. The fundus of the gallbladder was densely adherent to the duodenum and the sinus tract seemed to arise from this region. The common bile duct was about three times its normal size and contained normal bile as well as sandy and putty-like material. Scoops could be passed readily into the duodenum after some of this material had been removed from the ampullar region.

A T-tube was inserted in the common bile duct, and the gallbladder was removed from below.

In the region of the pylorus, the fundus of the gallbladder was attached, and a very hard, irregular mass, about 3 cm. in diameter, was felt. The exact nature of the mass could not be determined. Because of the age of the patient, the possibility of a malignant lesion and the certainty of future mechanical obstruction, it seemed advisable to perform a partial gastric resection and remove the mass in its entirety along with a small rim of the duodenum. Gastro-intestinal continuity was reëstablished by means of a posterior Pólya type of anastomosis. The liver and pancreas were normal. A split-tube was left in Morison's pouch. The surgical specimen is shown in Figure 1. Examination of the specimen by a pathologist disclosed subacute cholecystitis superimposed on chronic cholecystitis. The walls of the gallbladder were moderately thickened and infiltrated. The gallbladder contained multiple stones which varied from 0.5 to 1 cm. in diameter. The other specimen contained 11.5 cm. of the stomach and 1 cm. of the duodenum. An inflamed cholecystogastroduodenal fistula, 3.5 cm. long, extended obliquely and distally from a serosal opening, situated 2 cm. proximal to the pyloric ring, on the anterior wall of the stomach, to a mucosal opening in the duodenum, 1 cm. distal to the pyloric ring. The fistula contained multiple stones, the largest of which was 1.5 cm. in diameter. Some of the calculi were as small as grains of sand.

The hard, irregular mass felt in the pylorus was the collection of stones. The cholecystogastroduodenal fistula was projected outward to the cutaneous border.

The patient again had an uneventful convalescence except for a slight separation and undermining of the skin edges of the wound at the level of the T-tube. He was dismissed from the hospital in good condition on March 6, 1941. The T-tube was still in place and was clamped at all times except for an hour after meals.

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# SOLITARY DIVERTICULITIS OF THE CECUM

## REPORT OF TWO CASES

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THE INABILITY TO DIFFERENTIATE acute appendicitis preoperatively, and carcinoma at operation, from the usual findings of an inflamed cecal diverticulum makes a consideration of this subject of prime importance. Baker and Carlisle,[1] in reporting 39 cases, found 14 radical resections had been carried out, many on a presumptive diagnosis of carcinoma. Preoperatively, all but four cases in which a diagnosis was made had been thought to be appendicitis of some type. The possibility of solitary diverticulitis of the cecum should always be considered when examining a patient who has had a previous appendicectomy and who complains of right lower quadrant pain. Furthermore, when operating for appendicitis and finding an apparently normal appendix, a careful search for cecal diverticulitis should be made. Two cases of solitary diverticulitis of the cecum occurring in young males, which were encountered during a period of one year at a large station hospital, are reported.

### CASE REPORTS

**Case 1.**—A male, age 30, was admitted August 15, 1943. He stated he had been well until four days prior to admission. At that time he began having pain in the abdomen that was continuous and of mild to moderate intensity. The day of admission, pain localized in right lower quadrant. There was no nausea or vomiting, and no urinary symptoms. He took milk of magnesia the night before admission and his bowels moved the following day. His habits, family history and previous personal history were not remarkable.

*Physical Examination.*—This was normal with the exception of marked tenderness in the right lower abdominal quadrant, with some rigidity and spasm of muscles of this quadrant. Temperature 99.4° F.; pulse 76; respirations 18. Leukocyte count 15,000, with 76 per cent polys. Uranalysis—negative. *Diagnosis:* Acute appendicitis.

*Operation.*—Through a McBurney incision, the cecum and lower ascending colon was delivered and the omentum was found adherent to an inflamed area on the anterior, medial, wall of the cecum, at the junction of the terminal ileum with the cecum. Examination revealed an intensely inflamed diverticulum where the omentum was adherent, which had become suppurative and appeared to be the seat of a recent perforation. The attached omentum was divided from the mass and the entire mass was excised by an elliptical incision. The defect was repaired with a running Kerr stitch reinforced with a double layer of interrupted Dulox sutures. The appendix was removed. Five grams of sulfanilamide was deposited in the area, and the wound was closed in layers without drainage.

*Pathologic Examination.*—The specimen consists of a circular segment of large bowel to which there is attached a diverticulum. The tissue is swollen and friable. The specimen, after fixation, measures approximately 4 x 3 x 1.5 cm. On the mucosal side of the specimen there is an opening which communicates with the diverticulum. On sectioning, the diverticulum is seen to be markedly inflamed and necrotic. It is filled with a large fecalith, which has a diameter of approximately 0.7 cm. Sections showed

the diverticulum lined with typical large bowel mucosa. The muscularis mucosa is intact and the muscular wall of the diverticulum is also present. The entire wall is acutely inflamed and in some areas is undergoing necrosis. *Pathologic Diagnosis:* Acutely inflamed, necrotic, true diverticulum of the cecum.

Convalescence was uneventful, and the patient has continued on active duty, with no disability. Barium enema on November 8, 1944, showed no evidence of diverticula or pathologic changes other than those made at operation (Fig. 1).

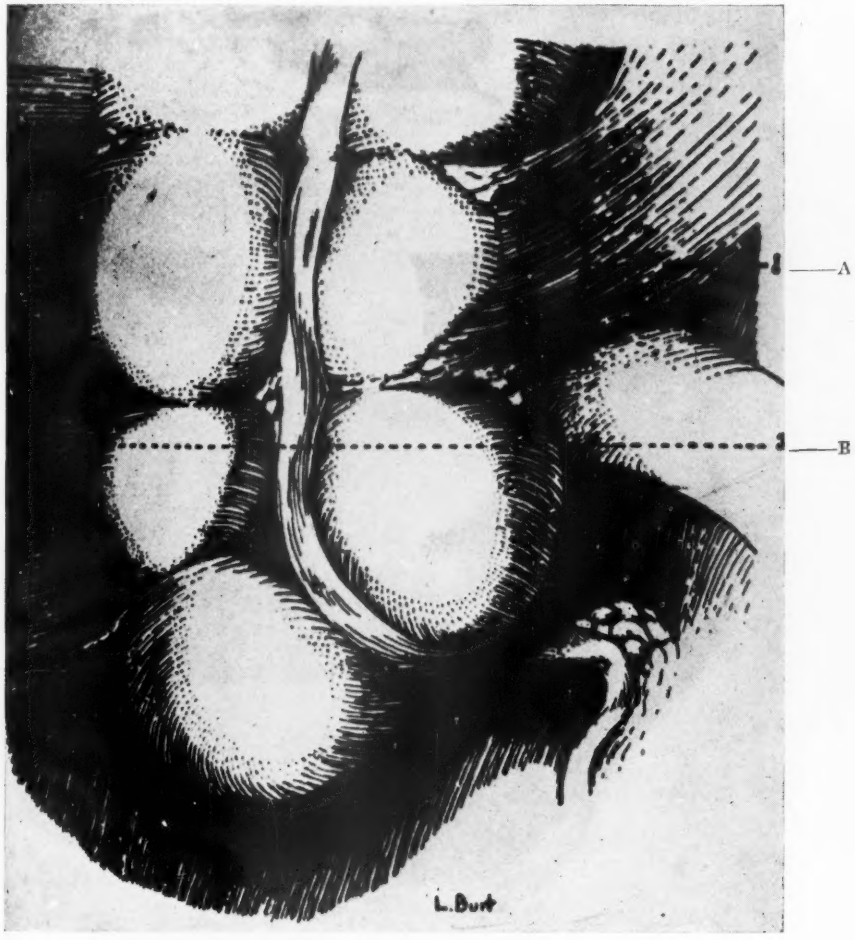


FIG. 1.—Diagrammatic sketch showing location of diverticula.

A. Case 1
B. Case 2

**Case 2.**—A colored male, age 21, was admitted June 15, 1944. He stated he had been ill for the past four days with generalized pain in the abdomen. The pain remained generalized until the morning of admission, when it became more severe and localized in the right lower quadrant. He was not nauseated and did not vomit. In fact, he was able to eat as well during this period as at any other time. He had had no previous attacks of abdominal pain, and had been well most of his life, other than for moderate constipation. His habits and family history were negative. He had gonorrhea five years ago, and had been treated for syphilis. His Kahn test for syphilis was negative.

*Physical Examination.*—This was normal except for the abdomen, where there was marked tenderness in right lower quadrant, rebound tenderness, and muscle spasm. Temperature 99.8° F.; pulse 88; respirations 20. Leukocyte count 11,550, with 85 per cent polys. Uranalysis—negative. *Diagnosis:* Acute appendicitis.

*Operation.*—The abdomen was opened through a McBurney incision. Exploration revealed the appendix to be grossly normal. There was a palpable retroperitoneal mass, about the size of a hen's egg, on the lateral border of the cecum. Because of this, the incision was enlarged through a Weir extension. The cecum and lower portion of the

FIG. 2

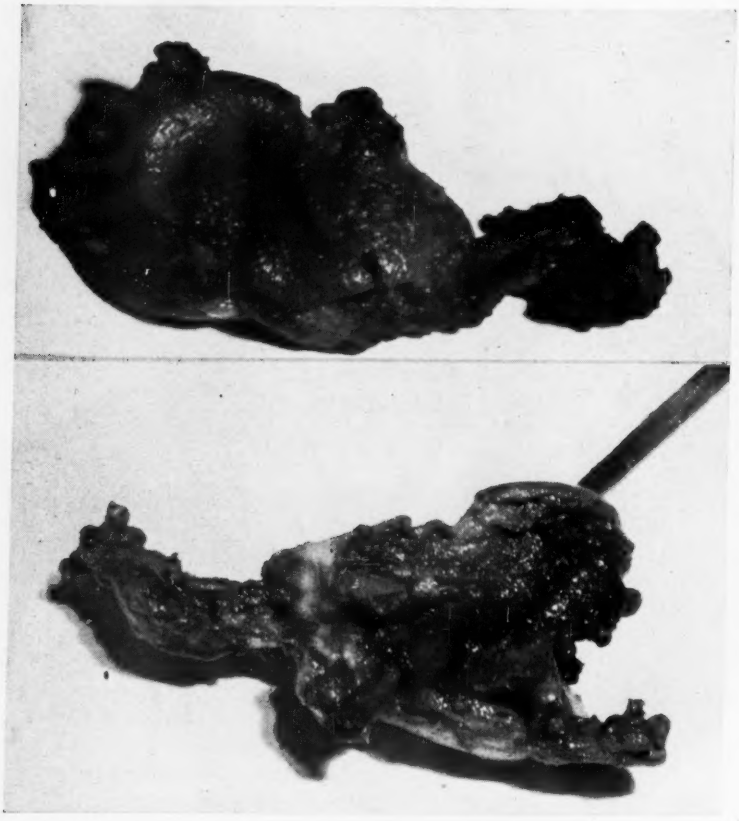

FIG. 3

FIG. 2.—Resected specimen. Case 2. Viewed from inside showing diverticulum.
FIG. 3.—Resected specimen. Case 2. Viewed from outside with probe through perforation in diverticulum.

ascending colon were mobilized by dividing the lateral border of the peritoneum. This exposed the mass which appeared to be inflammatory. The remainder of the cecum and lower ascending colon appeared normal. After carefully dissecting through what appeared to be a thick layer of inflamed fatty tissue, the cause was found to be a perforated diverticulum. This was excised through an elliptical incision, and the defect repaired by continuous Connell suture, reinforced by interrupted Lembert sutures. The appendix was removed, five grams of sulfanilamide placed in the abdomen, and the wound closed in layers after inserting one Penrose drain.

*Pathologic Examination.*—The specimen consists of a spherical piece of large bowel wall. After fixation, this specimen measures approximately 3 x 2 cm. Directly in the center of this tissue there is an opening, which measures approximately 3 mm. in diameter. This opening leads into a diverticulum. This diverticulum is perforated at its attachment to the bowel wall. Surrounding the diverticulum, there is a marked inflammatory reaction (Fig. 2). The wall of the diverticulum on cut-section is seen to be necrotic. Sections showed the diverticulum lined by typical large bowel mucosa. The muscularis mucosa is intact excepting for the region in the area of the perforation;

FIG. 4.—X-ray of barium enema. Case 1. 14 months after operation.

the muscularis is absent. The wall of the diverticulum is seen to be necrotic, and there is an acute inflammatory reaction present. The acute inflammatory process is diffuse throughout the wall of the diverticulum, but is most marked in the perforated area (Fig. 3). The inflammatory process has spread to the attached soft tissue. Examination of the appendix revealed a subacute diffuse inflammatory process. *Pathologic Diagnosis:* (1) Acutely inflamed, perforated, false diverticulum of the cecum. (2) Subacute diffuse appendicitis.

Convalescence was uneventful. The drain was removed on the fourth day, and the wound healed *per primam.* Barium enema, August 24, 1944, showed no evidence of

other diverticula or pathologic changes other than made at operation (Fig. 4). He returned to combat duty.

Case 1 represents the congenital, or true type, of diverticulum, as distinguished by being made up of all the normal layers of the large intestine. Case 2 is the acquired, or false type, the muscularis being absent (Fig. 5).

FIG. 5.—X-ray of barium enema. Case 2, 2 months, 9 days after operation.

The first case report of a patient with diverticulitis of the cecum was made by Portier[2] in 1912. In 1942, Schnug[5] found 32 cases, and reported six of his own—a total of 38. In 1943, Baker and Carlisle[1] reviewed the American and British literature for the past 20 years, and found 37 cases, adding two of their own. Carroll,[2] about the same time, searched the literature, and reported 43 collected cases, to which he contributed one. Shortly following this, Fritz[3] added one case.

There is little in these reports that aids in differentiating this condition

preoperatively from acute appendicitis—the diagnosis most frequently made. Other preoperative diagnoses included appendiceal abscess, acute gangrenous appendicitis, perforating appendicitis, subacute appendicitis, chronic appendicitis, stump appendicitis, carcinoma of the cecum, and obturator hernia. The correct preoperative diagnosis was made on one patient. The temperatures varied from 97.4° F. to 102° F., Leukocyte counts from 6,000 to 23,000. The only symptom almost always present was tenderness in right lower quadrant of abdomen. Age was of value only in that a higher percentage were under 40 years, than in cases of multiple diverticulitis. Operative procedures included: drainage, local excision, inversion, extraperitonealization and partial ileocolectomy. The latter was performed a rather large number of times on a mistaken impression of process being malignant. The results of treatment were rather remarkable, in that there were only two deaths. Schnug,[5] in concluding, states: "A radical excision of the mass by resection and anastomosis is definitely not indicated. A local excision and closure of the defect in most cases is probably not advisable. Except in those cases which have developed an abscess, and in which drainage is indicated, the abdomen should be closed without doing an appendicectomy and without drainage, and chemotherapy be instituted."

COMMENT.—Since the right lower quadrant of the abdomen is approached surgically so frequently, it is well for surgeons to keep this condition in mind, because in most cases local excision is all that is required to produce a permanent cure. This is in contradistinction to multiple diverticulitis, where most treatment is palliative. However, as pointed out by Jonas,[4] very large, inflamed diverticula lying close to the ileocecal valve, or between the leaves of the mesentery, so as to jeopardize the cecal blood supply, require extensive resection including, usually, the terminal ileum, cecum, and ascending colon, with anastomosis between the ileum and transverse colon.

The two cases here reported differed from Schnug's[5] experience, in that after excision of the diverticulum, the tissue edges of the bowel were remarkable because of their normalcy and the ease with which a firm closure was obtained. In fact, this was one of the most distinguishing features at operation; that is, the surrounding bowel in appearance and on palpation seemed so normal.

The symptoms and signs in the two reported cases were not such that they could be differentiated from appendicitis, and in this way agree with most reported cases. The lack of nausea and vomiting and the length of illness (four days) might suggest an atypical appendicitis, but certainly nothing further. Preoperative roentgenologic studies, besides being dangerous, would, in many cases, be of little value because frequently the diverticulum is filled with a fecalith, and would fail to visualize.

It is felt that associated appendicectomy, with local excision of the diverticulum, is justified, and does not increase the risk appreciably. In one of the cases reported, the appendix, microscopically, showed a diffuse inflammatory process and, if allowed to remain, would no doubt have caused trouble. The other was entirely normal.

## CONCLUSIONS

1. The importance of differentiating solitary diverticulitis of the cecum from carcinoma, at operation, is demonstrated.

2. Inability to differentiate this condition preoperatively from appendicitis has been pointed out.

3. Local excision of an inflamed cecal diverticulum will, in most cases, result in a permanent cure, and associated appendicectomy is indicated.

4. Two cases of solitary diverticulitis are reported.

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# A CONTINUOUS TRACTION SCREW FOR FIXATION OF FRACTURES OF THE HIP

REVIEW OF 23 CASES

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IN the treatment of fractures of the femoral neck, the authors have found a traction screw (designed by Virgin) to be a particularly efficient form of internal fixation. This appliance embodies a new feature consisting of a special spring arrangement that provides for a *take-up* in the event of absorption about the fracture line. Continuous apposition of the fractured surfaces is thereby ensured. A sufficient number of cases have been treated by the continuous traction screw, over a five-year period, to constitute a basis for end-result study.

## DESCRIPTION OF THE TRACTION SCREW (FIG. 1)

The screw may be made of 18-8 stainless steel or of vitallium.

The leading end of the instrument is made up of deep cutting threads, the design of which should be credited to Professor Howard Becker, of the University of Wisconsin. The threads are thin, and the roots cut deep, so that the maximum amount of unbroken cancellous bone is grasped between each two threads. In this way the screw is provided with great holding power, and the pull is spread over several square inches of thread surface. The leading cutting thread permits the screw to cut itself into position as the operator turns it. The edge of the last large thread is designed to cut its way backward to permit the removal of the screw.

The shaft is so strong that a powerful man cannot bend it. On the lower end of the shank is a washer, a spring, and a nut, arranged in order from above downward. The spring is so designed that it collapses within itself and takes up the minimal amount of space. Yet, the spring is capable of exerting a ten-pound continuous pull that provides for a *take-up* of five-eighths of an inch. The washer protects the femoral cortex from the sharp edges of the spring, and spreads out the traction force at the cortex, which is used as the base for the pull. Close to the end of the screw is threaded the nut, on standard threads, which allows for adjustment as to length during the fixation. The nut also provides for a *take-up,* allowing the spring to be tightened and reactivated in case the absorption of the femoral neck should total more than the five-eighths of an inch for which the spring provides. Finally, the end of the shank is squared-off to take a tap wrench chuck. The threads, however, are continued to the very end of the squared-off section, so that, if necessary, the nut can be backed to the end of the shank.

The only tools necessary for the insertion of the screw are a drill, of one-half-inch diameter, for opening the femoral cortex, a tap wrench with a one-quarter-inch chuck to receive the squared-off shank, and a one-half-inch T-handled socket wrench for tightening the nut. Ordinary pliers may be used in place of the wrench to turn the screw.

FIG. 1.—The continuous traction screw.

### TECHNIC OF APPLICATION

The technic of introducing the traction screw is essentially the same as that of inserting other fixation agents. Its insertion is extremely simple and may be carried out within from 20 to 30 minutes, even when correction of the position of the screw is required. Throughout the process of insertion, it is necessary to check repeatedly by roentgenograms both the direction and position of the screw. The roentgenograms should be taken in both the anteroposterior and lateral planes.

The length of the screw to be used is determined as follows: On an anteroposterior roentgenogram of the uninjured hip, the distance from the apex of the femoral head to the base of the greater trochanter is measured, and one-quarter of an inch is added to this measurement.

The preoperative preparation is carried out in the routine manner. Spinal anesthesia is used. The fragments are first accurately reduced, and the position is checked by roentgenograms taken in both the anteroposterior and lateral planes.

A simple guide for directing the screw is provided by the surface of the operating table, when the leg is maintained in the position of internal rotation during the introduction of the screw. Normally, as the patient lies on his back, the junction of the femoral neck and shaft falls backward. There is, therefore, a declination lateralward of the neck from the head, and the greater trochanter lies below the horizontal plane passing through the center of the femoral head. When the leg is rotated internally until the femoral neck lies parallel with the plane of the table, usually to an angle of 45 degrees, the greater trochanter rises from the table, and the plane running horizontally through the femoral head cuts through the center of the neck and the greater trochanter. This simple guide provided by the surface of the table, as well as the surgeon's knowledge that the femoral neck and shaft join at an angle of 127 degrees, facilitates the introduction of the screw.

A longitudinal incision is made in the skin on the lateral aspect of the thigh, extending downward from the region of the greater trochanter, and of sufficient length to allow easy approach. The subcutaneous tissues are

divided longitudinally by sharp and blunt dissection until the periosteum is exposed. Just below the greater trochanter, the periosteum is divided with a periosteal elevator, exposing the cortex.

The site for the entry of the drill is now determined as follows: The junction of the greater trochanter and the upper end of the femoral shaft is located. Here an arc extends gradually upward and outward from the shaft toward the overhanging greater trochanter. A line drawn through the center

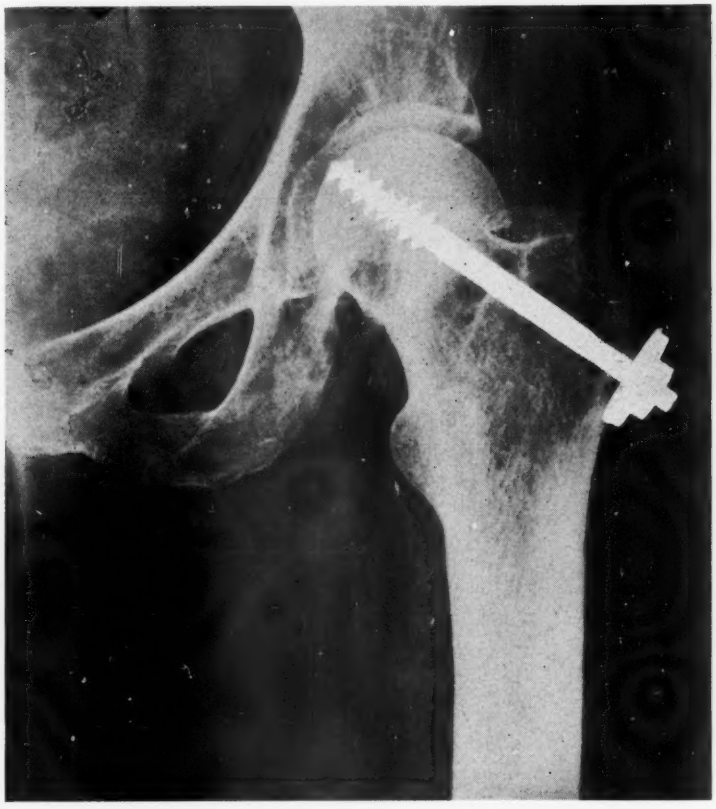


FIG. 2.—Roentgenogram of a case in which there was no absorption of the femoral neck, and, hence, no expansion of the spring.

of the femoral head cuts the center of this arc perpendicularly. The area on the lateral surface thus determined provides a relatively flat surface, at a right angle to the long shaft of the screw, on which to butt the washer and spring. In this way the best area for the proper spread of the pressure is obtained. At the center of the arc, the surgeon makes an aperture in the cortex with a one-half-inch drill.

The shank of the screw, with the washer, spring, and nut in place is fitted into the chuck of the tap wrench. The large threads of the screw are inserted into the drill-hole for about an inch, in the direction of the center of the femoral head, and the screw is turned until the leading threads lie within the confines of the bone. Anteroposterior and lateral roentgenograms

are taken to check the direction of the screw. Any necessary correction can be made by manual force for as much as 30 degrees in either the anteroposterior or lateral plane, such correction being possible because of the porosity of the cancellous bone, the strength of the shaft of the screw, and the thin and cutting quality of its threads. The screw is then turned into its final position, with the leading cutting thread stopped about one-quarter

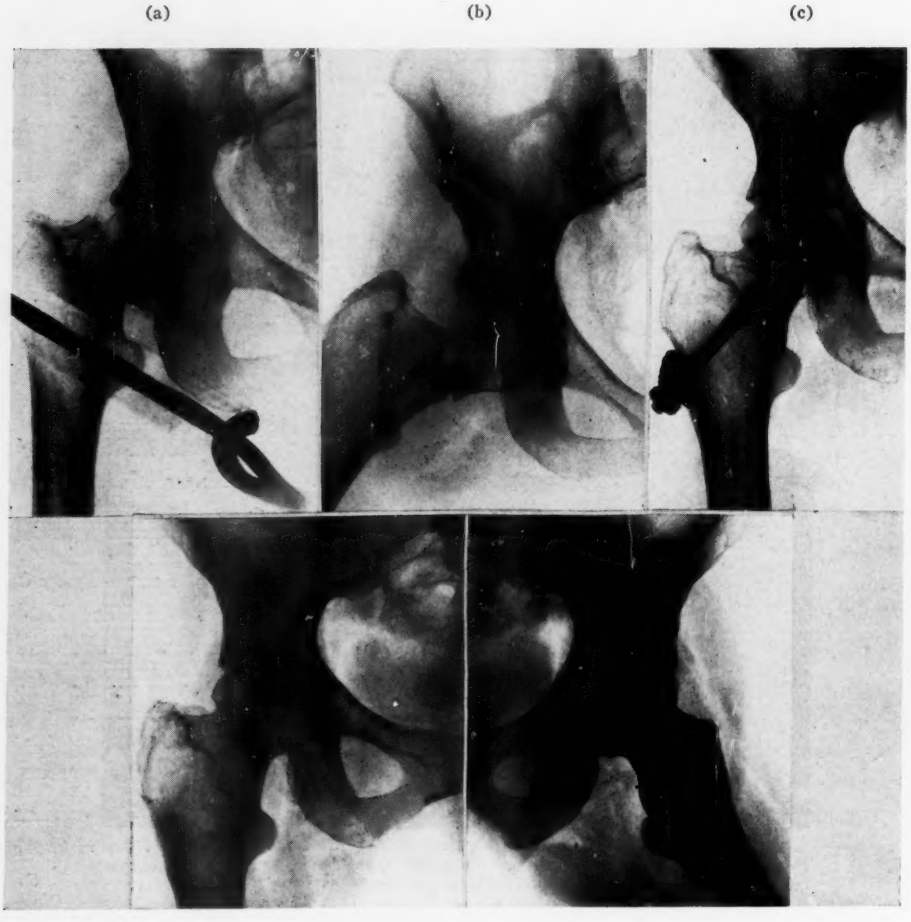
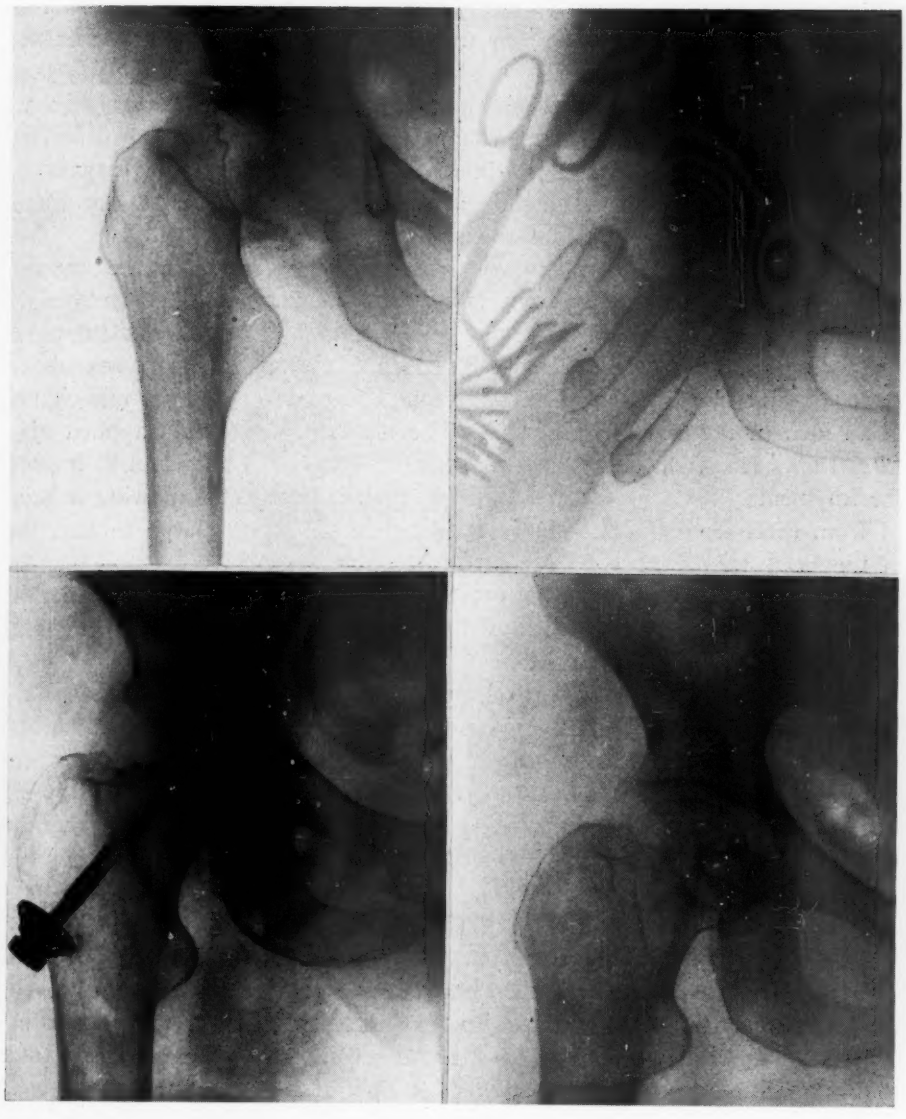



FIG. 3.—Case, S. E., in which there was slight absorption of the femoral neck, with a corresponding slight expansion of the spring.
(a) The original fracture.
(b) Roentgenogram following reduction.
(c) Screw in position seven months after reduction, showing slight expansion of the spring.
(d) Anteroposterior and lateral roentgenograms taken two years after the fracture.

of an inch from the apex of the head. It must be clearly understood that none of the large leading threads protrude from the head fragment, since this would defeat the pulling action of the spring. In other words, the fracture line must lie on the smooth, polished shank of the screw, so that in the event of absorption, the shank of the screw can slide, or be backed out,

(a) (b)



(c) (d)

FIG. 4.—Case, M. R., in which the spring expanded nearly to its full extent to take up the absorption of the femoral neck.

(a) The original fracture.

(b) Roentgenogram following reduction.

(c) Screw in position four months after reduction, showing expansion of the spring.

(d) Anteroposterior roentgenogram taken four years after the fracture, showing bony union with absorption of the femoral neck, necrosis of the head, and arthritic changes.

by the action of the spring, in order to pull the head fragment down onto the shaft. The surgeon is aided in controlling the depth by his knowledge that six complete turns of the screw advance it for a distance of one inch. The position and progress of the screw are guided by roentgenographic examination.

The soft tissues are separated by retractors to allow the washer to impinge against the bone. At this stage the spring is usually collapsed. The nut is adjusted with the socket wrench in order to impact the fragments. Considerable manual effort must be exerted to tighten the nut, but there need be no fear of pulling out the screw.

In case the screw is found to be too long, its progress should be stopped at a point one-quarter of an inch from the articular surface, even though the spring has not collapsed. The nut is then turned down on the shank until the spring collapses. If the screw proves to be short, the tap wrench is removed, and the nut turned backward until it comes to within one-eighth of an inch of the end of the shank. The tap wrench is again applied and turned until it is tight, collapsing the spring. The nut is tightened to impact the fragments. This process may be repeated, if necessary, allowing a gain of from three-eighths to one-half of an inch, until all the large threads lie in the head fragment.

The next step is to move the extremity freely in all directions. In this way the surgeon may demonstrate not only that the fixation is firm, but also that the hip motion is free.

Closure of the wound is carried out by allowing the deep tissues to fall together over the spring and the protruding end of the screw, and then suturing them with a single, or at the most, with two loose stitches of catgut. All dead spaces are closed with loose interrupted sutures, and the skin is closed with interrupted silk sutures. A dressing is applied, and the motion is again tested.

### POSTOPERATIVE CARE

When the patient recovers from the anesthesia, it is well to demonstrate to him that the artificial union is strong and that the joint can be moved freely. At the same time, it should be explained that the screw is not to be considered a substitute for bone. On the second day, the surgeon should again move the hip, trying to obtain the cooperation of the patient.

The patient is permitted to move about the bed at will and the nursing care may be carried on in the usual manner. Contraction of the quadriceps muscle should be practiced while the patient lies in bed, to promote the circulation and muscle tonicity. On the third postoperative day, the patient is encouraged to begin active motion by sitting on the edge of the bed and extending the knee. Wheel chair privilege may also be extended about this time. At the end of the first week, the patient may begin to walk with the aid of crutches, keeping the injured foot off the floor. Walking with crutches is made easier if the patient first practices standing by steadying himself with

the toe of the injured extremity touching the floor, and by attempting to walk about the end of the bed, bearing weight on the well leg and dragging the injured limb. At any time after the operative reaction has safely passed, the patient may go home.

Unqualified weight-bearing is not allowed until the roentgenograms show good bony union. This is usually from the fourth to the sixth postoperative month. In view of the uncertainty of the duration of the healing period, it is well to refrain from discussing the time of weight-bearing with the patient.

FIG. 5.—Roentgenogram of a case with destruction of the femoral neck, in which the spring took-up approximately seven-eighths of an inch of absorption.

When the union is solid, the screw may be removed. No difficulty is encountered in its removal, even though the screw is held tightly in the bone.

### INDICATIONS FOR THE USE OF THE SCREW

The screw may be used in treating the subcapital fracture, and the transcervical fracture in either the midneck of the femur or at its base.

In the selection of fractures for screw fixation, the patient's age and general condition must be considered. Extreme senility is not a contraindication, provided the general condition is fair. The fact that the introduction of the screw is easy and requires little time, as well as the early postoperative activity made possible by such fixation, warrants considering the procedure in elderly patients. The oldest patient in the series of cases being reported was age 89.

### ADVANTAGES OF THE CONTINUOUS TRACTION SCREW

By the nature of its design, the traction screw satisfies all the recognized principles of efficient internal fixation. It is easy to insert, because the screw cuts itself in, requiring no guide or reaming of the bone, and no blows to position it. Under such circumstances, the shock is minimal, and there is little traumatization of the soft structures and bone tissue, which ensures better preservation of the blood supply to the femoral head and neck.

The screw meets the requirements of rigidity in a fixation agent. It is strong and there has been no instance of its breaking or bending. Throughout the entire healing period, it remains fixed in place, making it possible for the patient to be cared for easily and to resume activity early. The danger of the development of pulmonary complications is lessened, the patient is more comfortable, and the period of hospitalization is shortened. So complete is the immobilization obtained by the screw that the patient may be ambulatory with the aid of crutches within a week.

Close coaptation of the fragments is ensured, when the fractured surfaces are forced together, by the grip of the large cutting threads on the femoral head. There is no danger of pulling the screw loose from the head, since in its introduction, no segments of bone between the threads are broken off, and the pull is spread through the entire depth of the fragment. The firm apposition and impaction of the fragments prevent any rotation of the femoral head on the screw.

Not only is close apposition of the fragments ensured by the continuous traction screw, but actual *pressure* contact of the fractured surfaces is established. By means of the special spring embodied in the screw, this pressure is exerted throughout the entire healing period. As late as six months following the fracture, when the screw may be removed, the spring is found to be still maintaining some pressure.

By means of the spring arrangement, the fragments are maintained in apposition, even though absorption takes place at the site of the fracture. Herein the traction screw has its greatest advantage over other fixation appliances. Many of the immobilizing agents in use at present are of the screw-bolt type, their originators having recognized the limitations and defects of nail and wire fixation, due to traumatic introduction, slipping, and the failure to maintain close apposition of the fragments. Outstanding among the screw-bolt appliances are those designed by Henry, Lippmann, Henderson, Putti, and Godoy-Moreira. None of these methods, however, provides for continuous internal traction in the event of absorption.

### ANALYSIS OF CASES

During the period from March, 1939, to March, 1943, the continuous traction screw was used in 23 cases. Nineteen of the patients were females. The ages ranged from 43 to 89 years; six were over 80 years of age, and eight were in their seventies.

There were complications in eight cases. Two patients were unbalanced mentally, and one of these patients had an arthritic knee on the injured side.

Three patients had had cerebral hemorrhages, and one had had hypertension. One patient had a fracture of the femoral shaft on the injured side, and one patient had had a coronary attack and also was arthritic.

*Results.*—Six cases were deleted from the series of 23 cases. One of these patients, age 89, died within a few days of the operation. One patient died of cardiac failure a few months after the operation. Two patients died six months after the operation, one from pneumonia and the other from a cerebral hemorrhage. Two patients had been unable to report for a late roentgenographic examination, because they lived at a great distance from a hospital.

The results in the remaining 17 cases were estimated after a postoperative lapse of from one year and eight months to four years. The standard for a successful result was considered to be bony union with a minimum necrosis of the femoral head, good function with strength, walking with comfort, and freedom from pain. Clinically, 12 of the 17 patients obtained excellent or good results, as measured by the accepted standard. In three cases the results were only fair; two of these patients were confined to wheel chairs because of cerebral paralysis, and one had a good functional hip, but the motion was painful. In two of the cases in which nonunion resulted, the functional outcome was poor.

Bony union took place in 13 of the 17 cases, giving the percentage of 76.8. In only two cases was there appreciable necrosis of the femoral head. Varying degrees of absorption of the femoral neck occurred in five cases, and complete absorption in one case. In all instances the spring device proved to be effective in maintaining the apposition of the fragments.

## SUMMARY

The principle of continuous internal traction in the treatment of fractures of the hip appears to have been demonstrated for the first time.

In the series of cases that has been reported, the especially designed screw has demonstrated its effectiveness in providing for a *take-up,* and in maintaining the apposition of the fractured surfaces, when absorption of the femoral neck occurred.

This fixation instrument also meets adequately all the requirements of good internal fixation, including simplicity of insertion, firm apposition of the fragments, and rigidity.

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# RECURRENT INGUINAL HERNIA

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IT IS SURPRISING to find that in the voluminous literature on inguinal hernia, the articles on recurrences and the operative repair of recurrent inguinal herniae are relatively infrequent. In a good many of the textbooks and systems of surgery the subject is scarcely mentioned. Yet the correct surgical approach to this subject requires a great deal of judgment and experience, and not inconsiderable effort to effect a cure.

In this communication we wish to review our experiences with the methods of repair, and the types of recurrences encountered, and analyze the follow-up results in our series of 126 cases. It is felt that an analysis of the basic types of recurrent herniae encountered, together with the selection of a suitable operative procedure in each instance, will be of aid in guiding one's plans as to the type of repair to be carried out, and will reduce the incidence of secondary recurrences.

Statistics relating to the incidence of recurrence following primary herniorrhaphy vary a great deal. In most instances the recurrence rates average about 5%, although isolated series have been reported as low as 0%, and as high as 21%. It should be stated here that we feel that any hernia recurring at the site of the previous inguinal hernia repair should be considered a recurrent inguinal hernia, and we have so classified our cases. A good many surgeons feel that a high percentage of so-called recurrences are really incisional herniae, muscle-bulging due to weakness, *etc.*, and are not true inguinal herniae. However these herniae, whatever we may call them, are a result of the primary operation and in that sense are recurrences. It is also notable that these are prone to secondary recurrences. This variation in terminology accounts for some of the differences in statistical figures. The figures relating to secondary recurrences are difficult to find. These vary from 0% to 26%; and an approximate average is difficult to determine.

The present review consists of 126 cases, with 129 operations for recurrent hernia. In this group 72% were followed up to three years. It is interesting to note that four patients presented themselves with recurrent herniae which had previously been twice repaired, two in which three previous herniorrhaphies had been done, and one in which four repairs had been done. The recurrence rate following repair of this group of 126 cases was 3.1% or four cases.

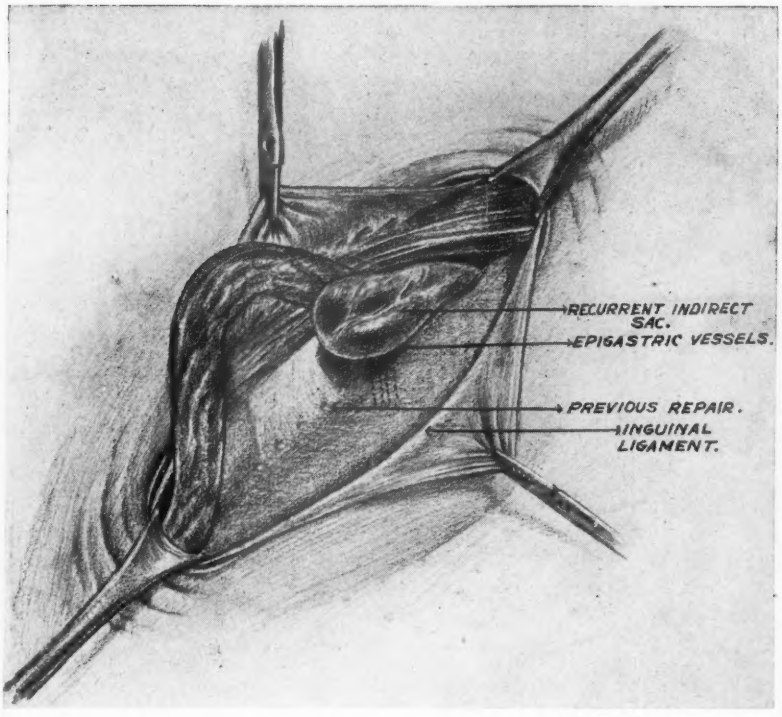


FIG. 1.—Indirect sac recurrence.

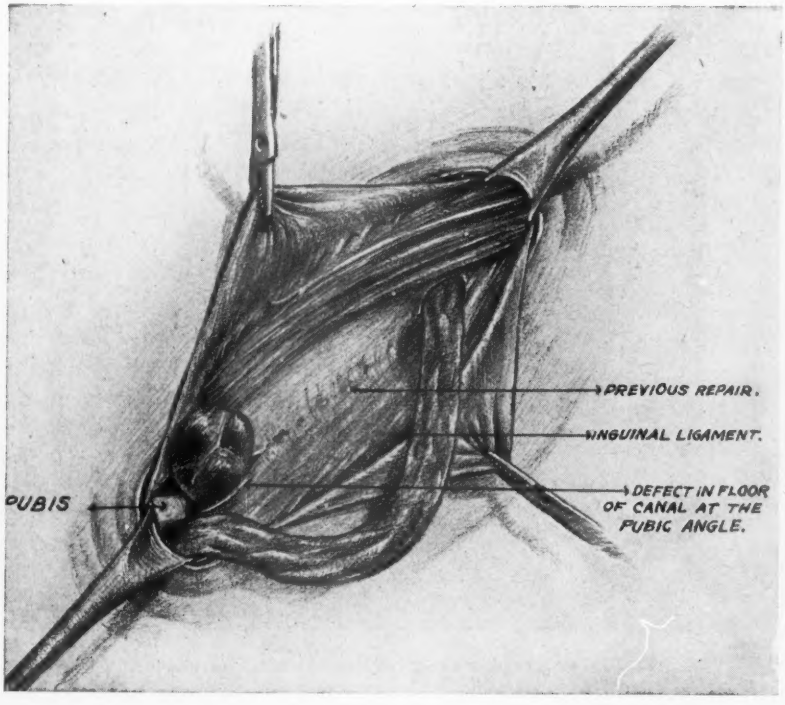


FIG. 2.—Direct recurrence at pubic angle.

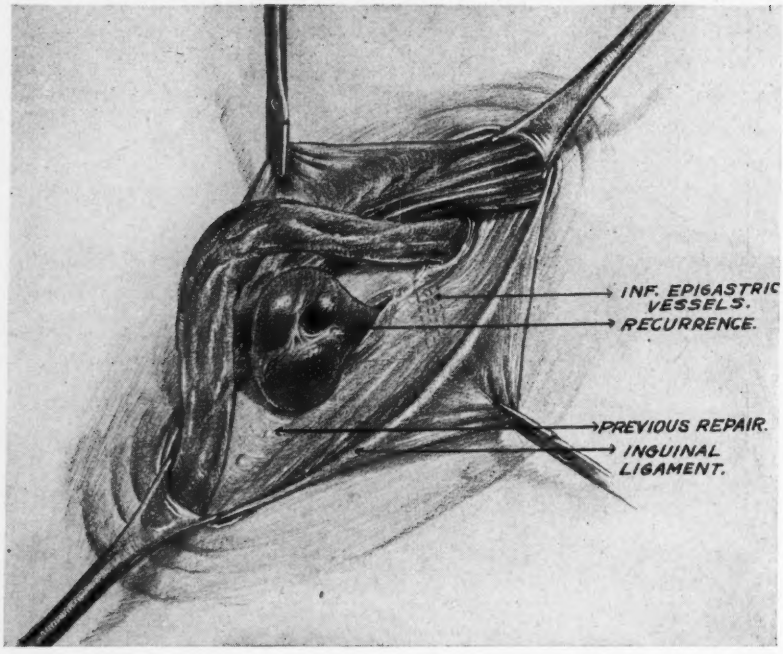


FIG. 3.—Recurrence between suture lines.

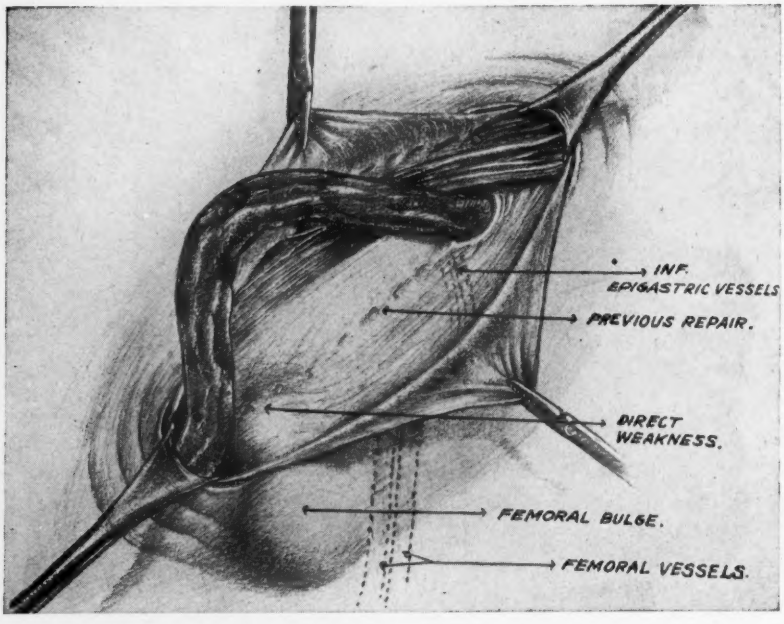


FIG. 4.—Combination direct and femoral recurrent hernia.

### CAUSES OF RECURRENCE

The cause of recurrence following primary or even secondary repair is of interest in discussing this subject. A number of factors have been indicted as contributing to recurrence and may be listed as follows:

1. *Body Build.*—This would include poor musculature; the absence or obliteration of the conjoined tendon; and the stretching out of fascial structures.

2. *Systemic factors,* such as coincidental disease; anemia; and recent weight loss and debility.

3. *Local Factors.*—These are probably the most common offenders and include the breaking of sutures, perhaps due to insertion under tension; the failure to obtain fascial approximation due to the interposition of fat or muscle; the failure of incomplete removal of the sac; the presence of hematomata; nerve injury and resulting muscular weakness. Postoperative cough and tension; and direct trauma. To this we would like to add the practice of bilateral, one-stage operation, as it has been shown in another paper that the incidence of recurrence is increased 13.5% by this procedure.

4. *Type of Work.*—The incidence of recurrence has been found in some series to be increased in those individuals doing heavy work with subsequent trauma and physical exhaustion.

In a group of 1126 primary hernia repairs our over-all incidence of recurrence was 1.89%; 1.94% for indirect; and 1.85% for direct herniae. These have been reported elsewhere.

### CAUSE OF SECONDARY RECURRENCE

The attempt has been made to estimate the major factors involved in secondary recurrences following recurrent hernia repair. It is our feeling that a good many secondary recurrences are the result of extremely poor structures encountered together with an inadequate repair or a poor choice of manner of repair. When operating upon recurrent hernia we expect poor structures—and this should not be a cause for recurrences, if the repair is correct. Infection may play a larger rôle in this type of hernia because of the dissection involved, and the presence of scar and partially devitalized tissue. Severe cough, pneumonia, and upper respiratory infections play a rôle and should be controlled or prevented if possible. The coöperation of the patient regarding postoperative rest and convalescent care is more necessary and must be more prolonged following these repairs. Direct trauma may also play a part. In one instance that we recall the secondary recurrence was caused by a fall on a sharp object. Two other secondary recurrences in our series were due to infection. The cause of the recurrence in the fourth case was not determined.

### THE TYPES OF RECURRENCES

The types of recurrences encountered in this series were rather varied, but would all fit into one of the forms shown in Figures 1 to 6. Almost all of the primary repairs had been done elsewhere, so that the actual method

of original repair was not known or tabulated, but it is our recollection that at operation the usual three basic varieties (regarding the position of the cord) were encountered. In several instances a previous fascial repair had been done.

The recurrence of the indirect inguinal hernial sac (Fig. 1) was fairly frequently encountered, and is a little hard to evaluate. It may be that some indirect sacs were not removed at the primary operation, but we do not feel that this was a very common cause. Perhaps the closed neck of the sac reopened following strain or tension, and left a peritoneal defect, with subsequent protrusion of abdominal contents and reperitonealization of the contiguous structures. In some instances the forming of a superimposed internal and external ring (as in the original Halsted repair), loosely closed may have allowed the peritoneum and contents to bulge and reform a hernial sac. In order to prevent the pulling out of sutures about the neck of the hernial sac and to prevent direct bulging out through the external and internal ring, we sometimes vary our method of closure of the neck of the sac and arrange the cord so there is a "staggering" of the internal and external ring. In the primary repair of the combined indirect and direct, or "pantaloon" hernia we do not as a rule use a purse-string suture or transfix the stump of the sac high under the internal oblique muscle because of the tension involved and subsequent danger of the sutures pulling out and, thus, leaving a peritoneal defect.

The recurrent hernia at the pubic angle (Fig. 2) is quite common, and is probably due to poor structures, the breaking of sutures due to excess tension, and the postoperative distension of the bladder. The careful placing of sutures without tension, a relaxing incision in the rectus sheath if necessary, and reinforcement with some type of fascial suture at the time of primary repair would largely aid in preventing this recurrence.

The recurrence due to an opening in the suture lines (Fig. 3) is a ventral postoperative hernia of the inguinal canal. Its causative factors are similar to those of any incisional hernia.

The combined recurrent hernia in the direct and femoral regions (Fig. 4) is not too common, and is somewhat more difficult to repair. It is felt that this hernia is commonly due to a weakening of the femoral region at the time of primary repair. It can be readily shown at operation that a suture joining the shelving edge of the inguinal ligament and the conjoined tendon lifts up the inguinal ligament, and, without any question, enlarges and tends to open up the femoral canal. This type of reconstruction is not an anatomic one. If, instead of the shelving edge the reflexion—the folded portion of the ligament farther anteriorly on the edge of the ligament—is used, the shelving edge is not displaced and weakening does not occur. An equally efficient repair is obtained.

The recurrent hernia (Fig. 5), characterized by a general weakness along the inguinal ligament, with the general bulging of preperitoneal fat and peritoneum beneath a large part or all of the inguinal ligament, is not common,

but does occur (seven cases in this series), and is extremely difficult to repair. It is felt that this is due to the use of the shelving edge of the ligament, as described above, together with a stretching and loosening of the entire ligament. In such instances the inguinal ligament is of little or no value as a structure to be used for repair.

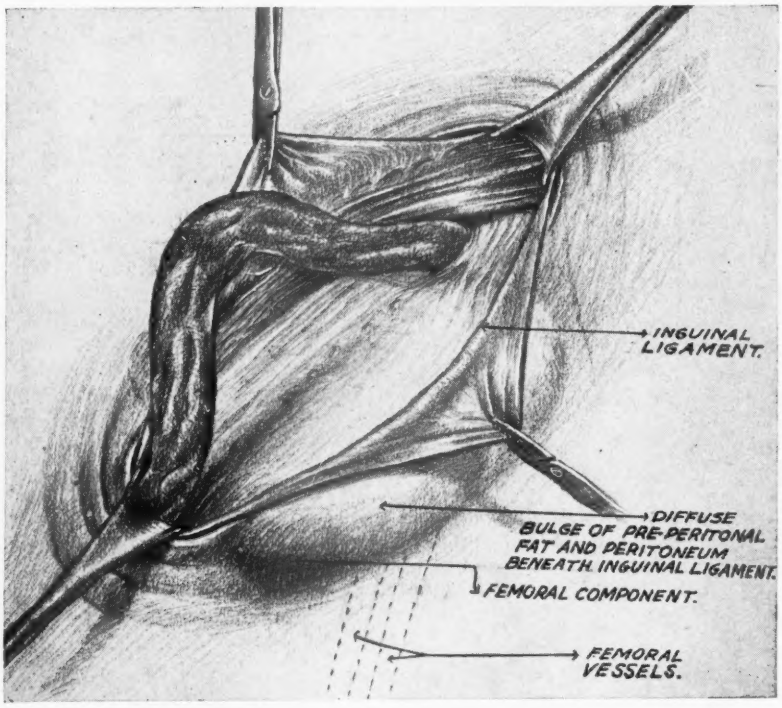
INGUINAL LIGAMENT.
DIFFUSE BULGE OF PRE-PERITONAL FAT AND PERITONEUM BENEATH INGUINAL LIGAMENT.
FEMORAL COMPONENT.
FEMORAL VESSELS.

FIG. 5.—Modified femoral recurrence with general bulge beneath inguinal ligament.

In describing the types of recurrences listed above we wish to state that these are considered basic types, from which variations occur. Every recurrent hernia encountered is different, but if the basic type can be determined at the time of operation, we feel that the logical plan for the most efficacious type of repair can be readily determined. We do not feel that any one type of repair can be suitable in all instances.

## METHODS OF REPAIR EMPLOYED

The methods of repair of inguinal hernia have about covered the range of possible procedures. While not listed this is also probably true of procedures used for recurrences. Our procedures have been limited to the employment of various reconstructive and fascial procedures from about the inguinal region itself together with the use of tissue from the fascia lata. Periosteal flaps, muscle transplants, *etc.*, have not been used. In some instances heterogeneous tissue such as ox fascia has been used but it is not felt to be as good as autogenous fascial material.

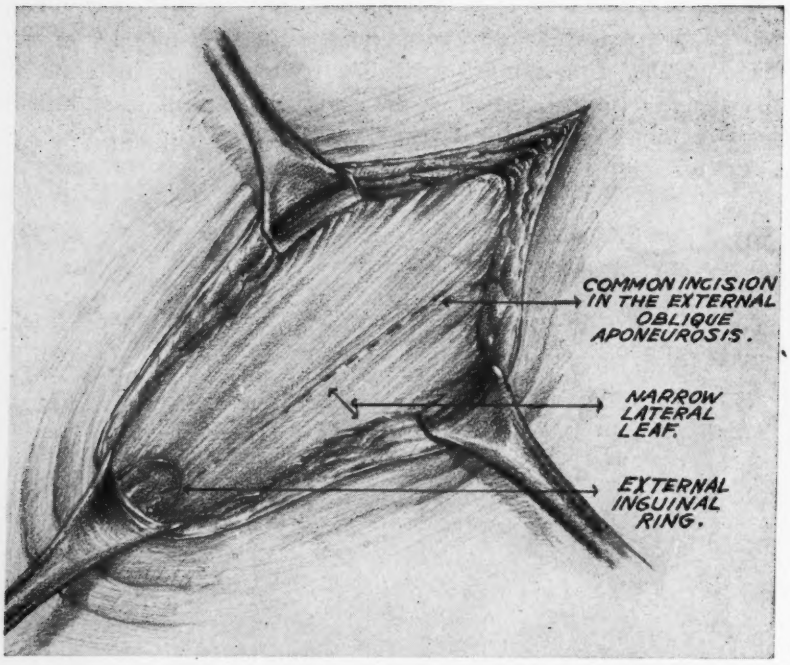


FIG. 6.—Usual incision in external oblique aponeurosis.

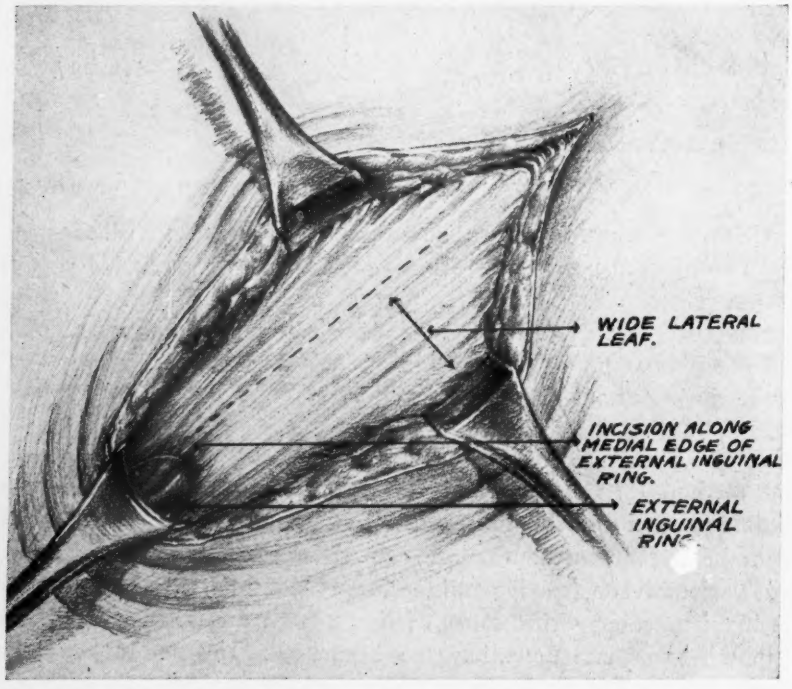


FIG. 7.—Medial incision in external oblique aponeurosis allowing adequate structures for repair without tension.

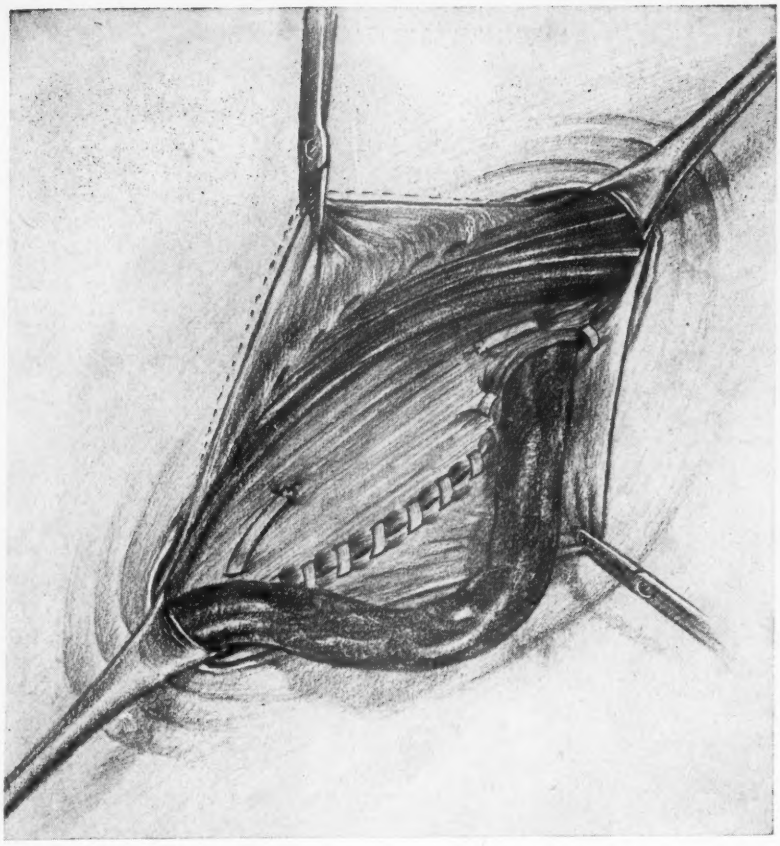

FIG. 8A.—Simple repair with fascia (placement of fascia).

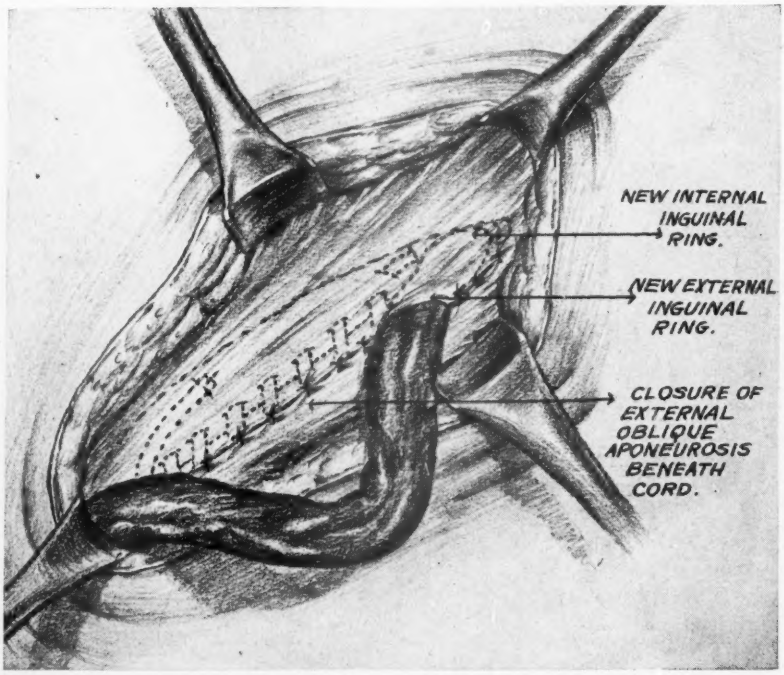


FIG. 8B.—Location of cord following repair. (A second layer of fascia may be placed in the edges of the external oblique aponeurosis.)

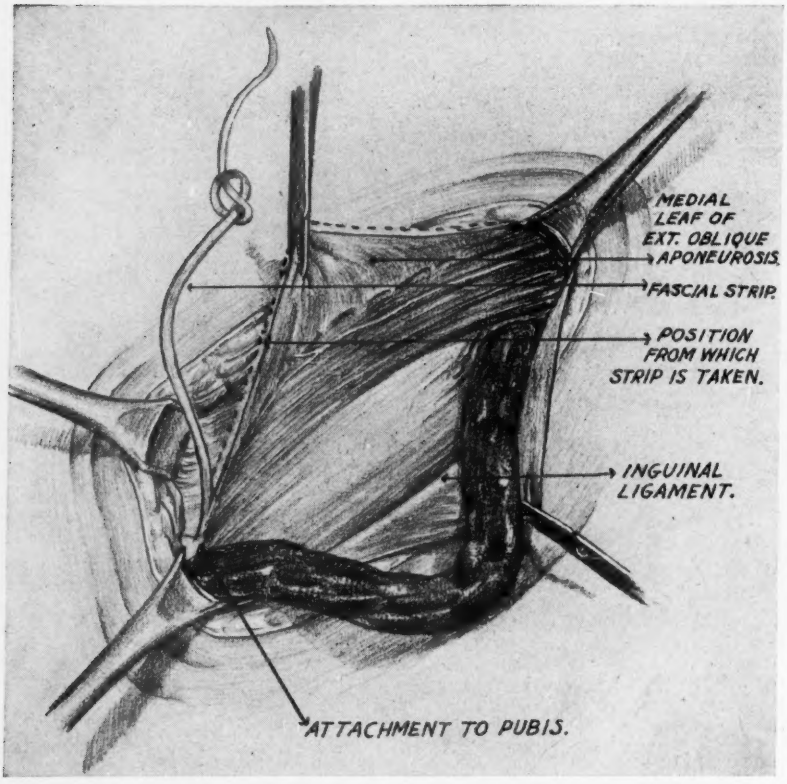


FIG. 9A.—Fascial strip from medial leaf of external oblique aponeurosis.

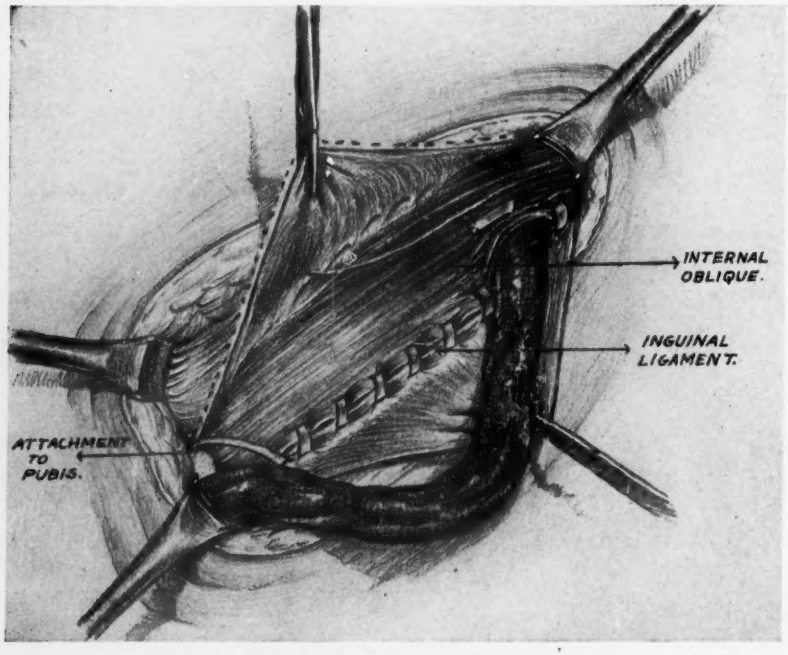


FIG. 9B.—Fascial strip sutured in place.

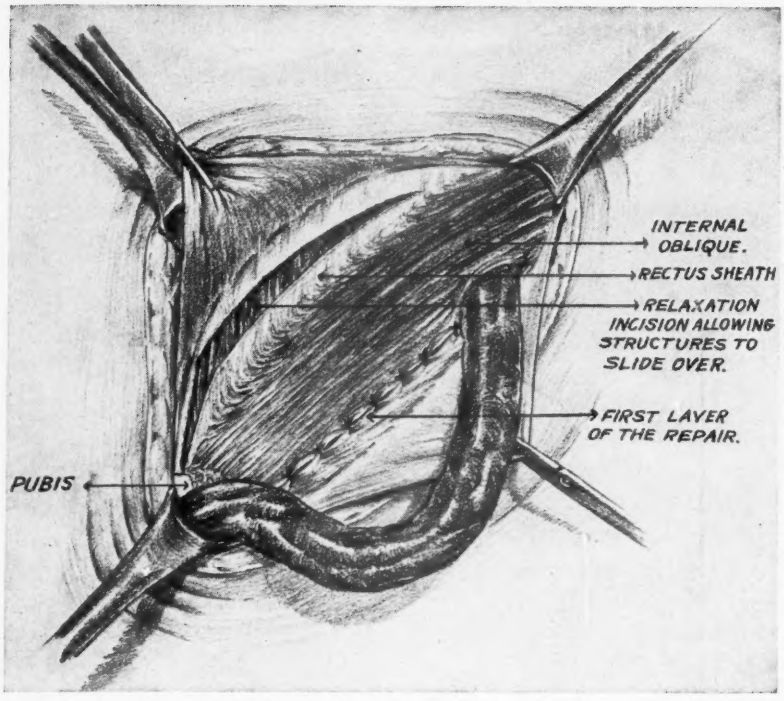


FIG. 10.—Relaxing incision.

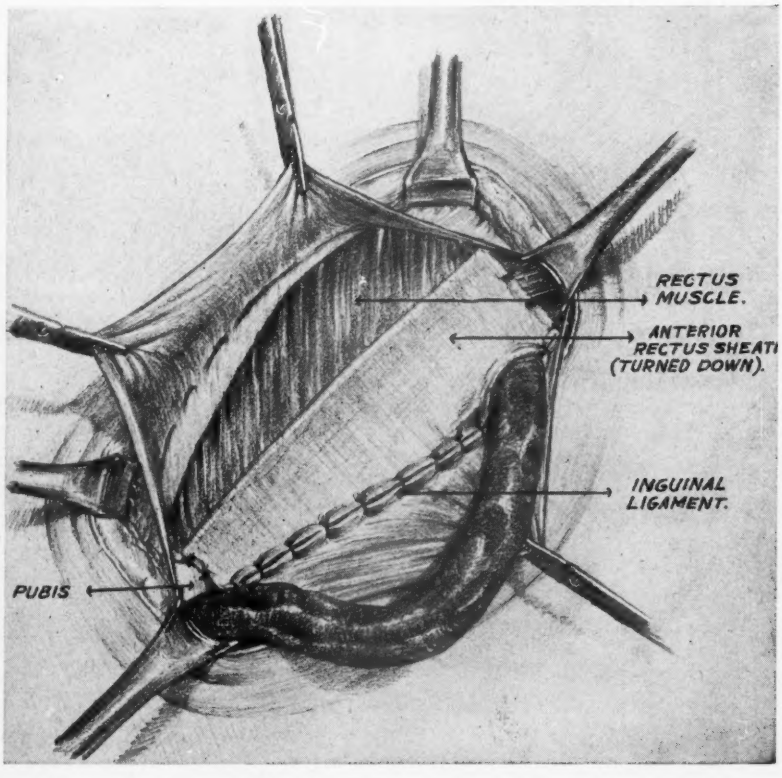


FIG. 11.—Use of cut rectus sheath.

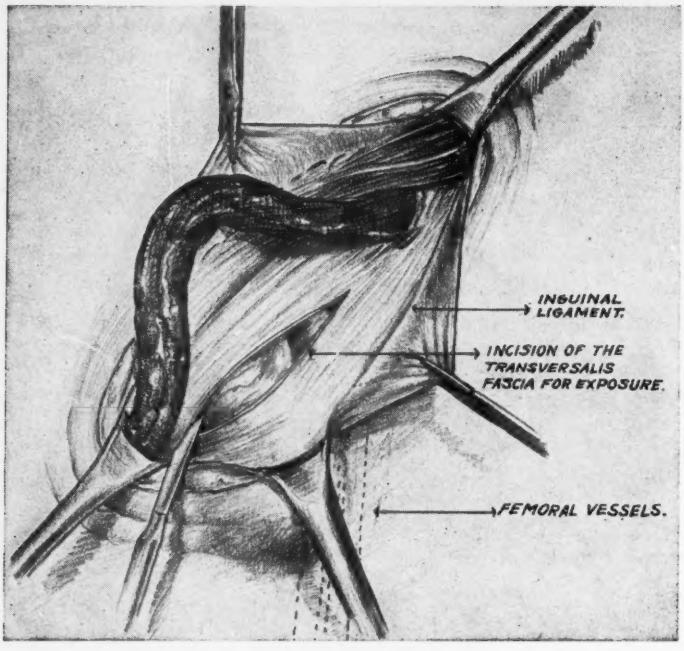


FIG. 12A.—The exposure.
Suture of inguinal ligament to the lacunar ligament and the Cooper's ligament for combination direct and femoral hernia (repair for hernia as in Fig. 4.).

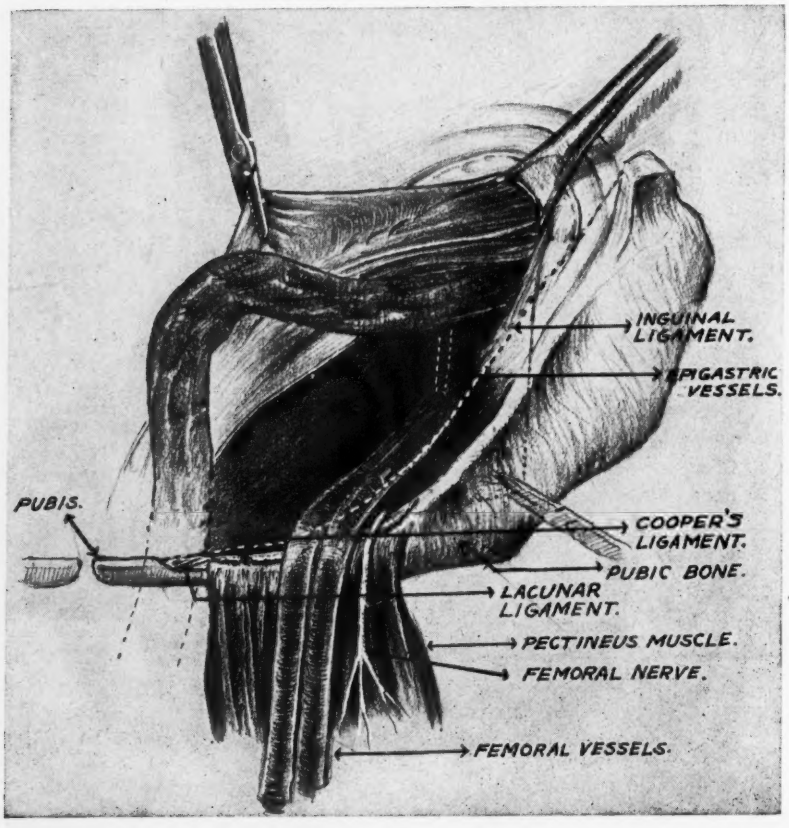


FIG. 12B.—Anterior view as above (with ligament removed for diagrammatic purposes).

In Figures 6 to 14 are shown the various operative procedures used in this series, with the exception of our usual type of primary hernia repair, which is illustrated in another article. Combinations of the procedures shown may also be used as indicated. This has been particularly true in

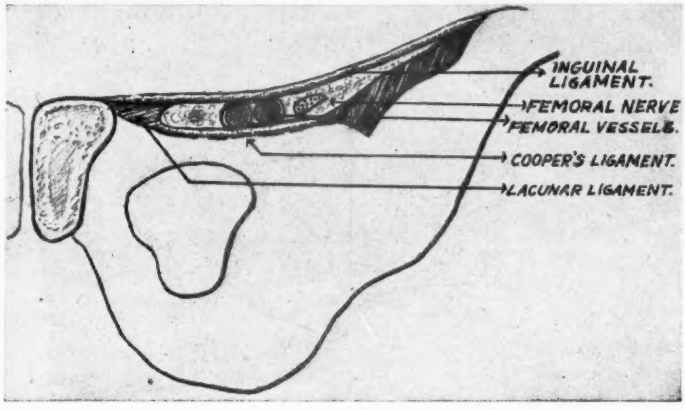


FIG. 12C.—Inferior view (before repair).

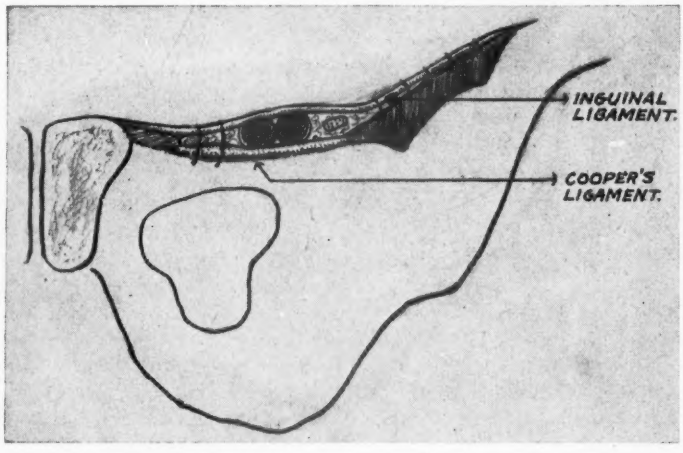


FIG. 12D.—Tightening of inguinal ligament and closure of femoral canal.

the use of the relaxation incision, as shown in Figure 9. Figures 6 and 7 show a point in the technic that we feel to be quite an aid in the carrying out of satisfactory repairs. The establishment of a fairly wide and good lateral edge of the external oblique aponeurosis allows the use of the reflexion of the inguinal ligament as mentioned previously, and gives one a fairly large flap of fascial tissue which can be handled easily in further repair.

In a number of recurrent herniae in this series, in which the primary repair had been done many years ago, almost virgin structures were encountered. In almost all instances these are of the recurrent indirect type.

When such is the case and these fascial structures can be separated easily layer by layer, and these structures appear to be composed of good firm tissue, a primary type of repair is carried out. If the separation by layers is readily accomplished but the structures are of poor quality, they are usually reinforced with fascia from the medial edge of the external oblique aponeurosis (Fig. 8) or from the fascia lata (Fig. 9). We feel that the use of autogenous fascia is very important in the repair of these herniae.

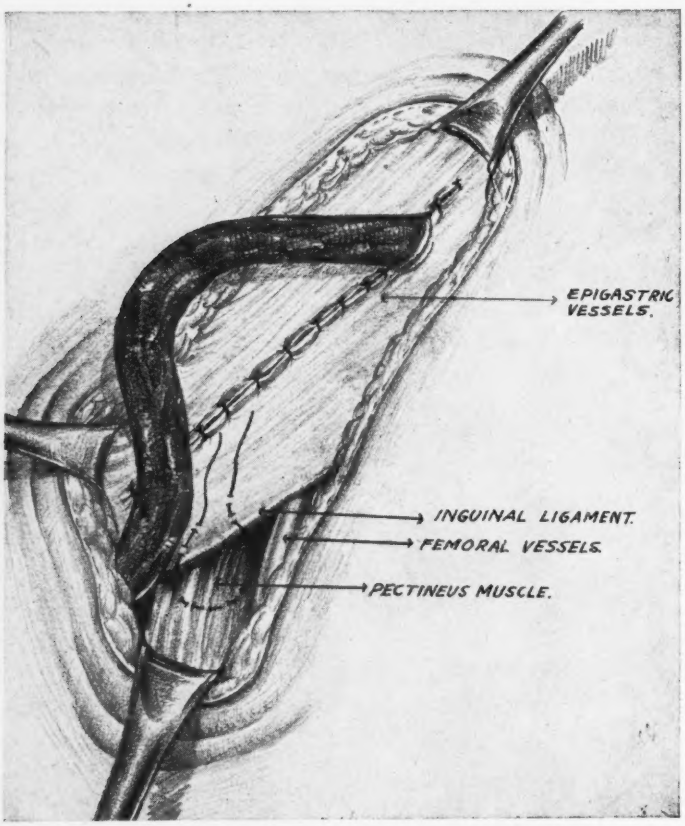


FIG. 12E.—Femoral closure may be reinforced from below.

The relaxation incision of the rectus sheath with or without a sliding over of the anterior rectus sheath, as described by Farr and Rienhoff (Fig. 10), is of considerable importance. The presence of scar tissue and the contraction of tissues as a result of the previous operation or operations tends to cause delayed healing and to increase the tension on the tissues. The relaxation incision allows the use of better structures and releases tension. It does not require repair and, in our experience, has never contributed to recurrence or caused muscle herniation or other local disturbance.

The suture of the inguinal ligament to the lacunar ligament, and to Cooper's ligament and the pectineus muscle fascia, as shown in Figure 12, is

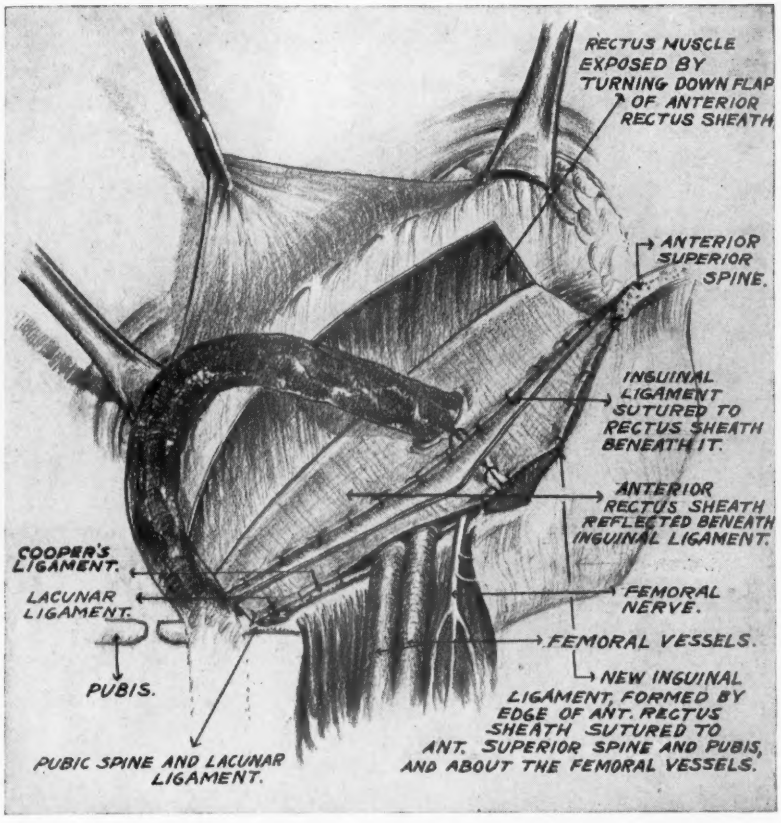
RECTUS MUSCLE EXPOSED BY TURNING DOWN FLAP OF ANTERIOR RECTUS SHEATH
ANTERIOR SUPERIOR SPINE.
INGUINAL LIGAMENT SUTURED TO RECTUS SHEATH BENEATH IT.
ANTERIOR RECTUS SHEATH REFLECTED BENEATH INGUINAL LIGAMENT.
COOPER'S LIGAMENT.
LACUNAR LIGAMENT.
FEMORAL NERVE.
FEMORAL VESSELS.
PUBIS.
NEW INGUINAL LIGAMENT, FORMED BY EDGE OF ANT. RECTUS SHEATH SUTURED TO ANT. SUPERIOR SPINE AND PUBIS, AND ABOUT THE FEMORAL VESSELS.
PUBIC SPINE AND LACUNAR LIGAMENT.

FIG. 13A.—Reconstruction of new inguinal ligament from edge of anterior rectus sheath (for type of recurrence shown in Fig. 5).

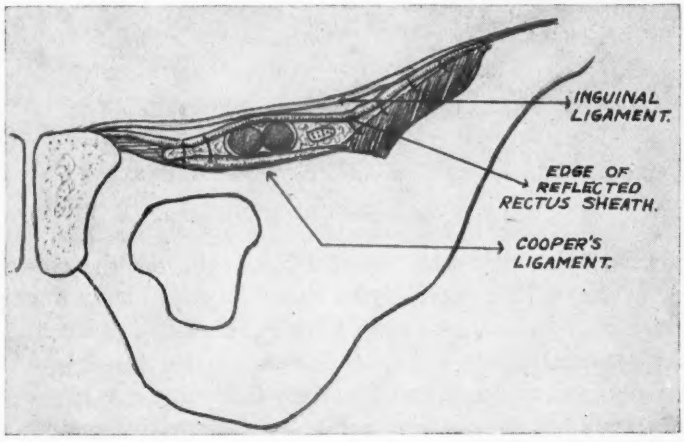


FIG. 13B.—Inferior view showing rectus sheath sutured beneath the inguinal ligament.

used for the recurrent type of hernia shown in Figure 4. This type of repair requires quite a bit more dissection and is a combination of inguinal and femoral hernia repair. A strip of fascia lata may be required to reinforce the direct area, but if used should be placed carefully so that no tension is put on the shelving portion of the lacunar ligament and Cooper's ligament.

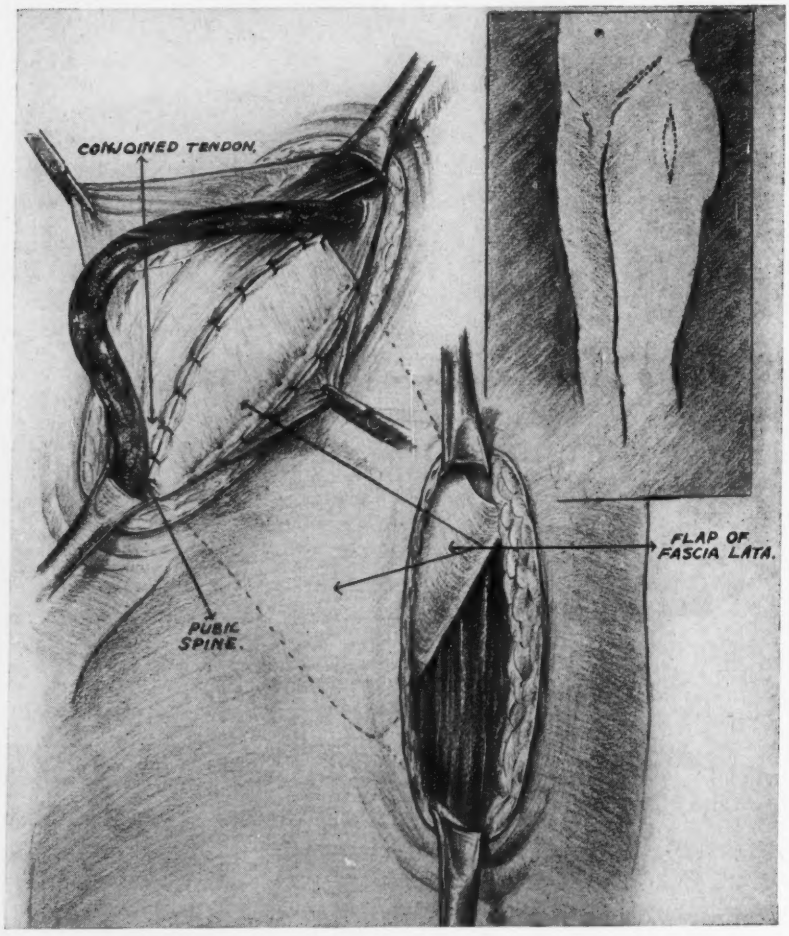


FIG. 14.—Wangensteen fascial flap repair.

The reconstruction of a new inguinal ligament from the cut-edge of the anterior rectus sheath (Fig. 13), has been used by one of us in three instances, with good results. In this procedure an adequate flap is turned down from the anterior rectus sheath. This flap is then carried beneath the stretched out inguinal ligament and is sutured to the pubic spine, the lacunar ligament, Cooper's ligament, about the femoral vessels, respectively, and if desired, or necessary, may be made long enough to be attached to the anterior superior spine. This would then create a new adherent inguinal ligament. The defect in the anterior rectus sheath is covered when the external oblique

aponeurosis is brought together and creates no weakness. We have not been able to find in the literature the description of a similar procedure. Halsted has described a rectus sheath flap operation in which the rectus sheath is sutured to the inguinal ligament, but this is not as described in Figure 13 in this paper. McVay-Lotheissen, and Swenson and Harkins, have described a procedure in which the conjoined tendon is sutured to Cooper's ligament. This is somewhat similar to the procedure described above. This repair we have used in the type of hernia shown in Figure 5, in which the entire inguinal ligament is loosened and frayed-out, and is of no value for use in the repair. It seems likely that this procedure could be used for other recurrences also, such as that shown in Figure 4.

The Wangensteen repair, using a turned-up flap of fascia lata, as shown in Figure 14, we have usually reserved for correction of this type of hernia (shown in Figure 5) until the repair described in the preceding paragraph was started. The Wangensteen repair was used in four of our cases, with good results. It involves a great deal of dissection; including dissection on the thigh, and there is usually some local bulging and slight deformity of the thigh for a period of time. It was for this reason that the previously described operation (Fig. 15) was devised. The repair, using the Wangensteen procedure, however, is undoubtedly excellent.

There has been no mortality in this series of cases.

SUMMARY

1. A review of the statistics and causes of primary and secondary recurrences of inguinal hernia is given.

2. The basic types of recurrences in this series are illustrated and discussed.

3. The various repairs in this series are illustrated and discussed, and the repairs suitable for the various types of recurrences are offered for consideration.

4. One hundred twenty-six cases, with 129 operations are analyzed. There were four secondary recurrences, giving a secondary recurrence rate of 3.1%. There was no mortality.

5. The reconstruction of a new inguinal ligament using the edge of an anterior rectus sheath flap is described and illustrated.

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# THE PRESENT STATUS OF THE INJECTION TREATMENT OF HERNIA

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THE REVIVAL OF INTEREST in the injection treatment of hernia so apparent about ten years ago in many parts of the country seems to have subsided to a great degree. In the last five years I have seen no reports from responsible clinics advocating this form of treatment. In the previous five years, however, we can all recall the favorable reports of the success of this method which emanated from various clinics throughout the country. For example—Watson in his textbook on Hernia, published in 1938, quotes Rice, who collected from the literature 6550 cases treated by injection with 92.6 per cent cures. Other figures quoted by Watson[1] are: Larson 93.5 per cent cures; Wyss 91 per cent cures; Quillan 96 per cent, and Bratrud who states the recurrence rate following operation is 17 per cent and only 4 per cent following injection. These were certainly very glowing reports and along with many other similar figures were responsible for arousing such great interest in this form of treatment. In the light of all these favorable reports, it was felt that we, at the Ruptured and Crippled Hospital, should learn something about this treatment, and, consequently, in 1934, after being taught the method by one of its ardent protagonists, a group of 66 patients with 92 herniae were treated. The results of this study were published by Burdick and Coley[2] in 1937. They reported at that time 56 patients who were followed, and only 11 showed no definite evidence of recurrences and nine of these 11 were still wearing trusses. In a later check-up on these 11 patients we have found that not one was cured. These findings discouraged us in the use of the injection method.

This method, in our opinion, not only does not cure any hernia but actually complicates the condition to such a degree that any subsequent attempt at surgical repair lessens the patient's chance of a cure. Rice,[3] who in previous years had been one of the advocates of this method of treatment, seems to have lost some of his enthusiasm. In a personal communication this year he states: "I am now doing very little injection treatment of hernia though I still believe it has a narrow field of usefulness. I now use it only in slender individuals, and in these I believe good results can still be obtained." He states further: "I cannot give you my percentage of recurrences because I have not definitely checked them but it is my impression that if one uses it in the very thin people, the recurrence rate is extremely low."

The chief reason, however, in making this report is not to condemn the injection method for its failure to cure herniae but rather to condemn the dangerous statement that it is "all right to try the injection method as no harm is likely to come of it and we can always operate." Our interest in this subject was revived in the past few years by the increasing number of

patients coming to the hospital for operation who had previously been injected. Practically every one of these cases presented a difficult problem. The tissues in these previously injected cases showed marked fibrotic changes and had lost all their resiliency. In most of them a semicartilaginous ring of tissue was found about the internal ring. This firm, nonresilient ring of tissue was, in several cases, the cause of strangulation. The following case represents such a complication:

**Case Report.**—Patient E. M., emergency operation at Bellevue Hospital. Through the usual incision the external oblique was exposed. It was found to have a cadaveric appearance, and to be quite adherent to the internal oblique. On incision, a dark red, distended sac was exposed. This was incised and found to contain about one ounce of dark bloody fluid. The intestine was very dark and the blood supply was interfered with for a distance of some three inches. On relieving the constriction and applying hot towels, the intestine proved to be viable. The sac, which was about four centimeters in length, was separated. There were no adhesions within it but it was intimately adherent to the cord. The internal ring was very much infiltrated and had to be incised laterally before the intestine could be reduced. The opening therein admitted two fingers; apparently there were firm adhesions throughout the rest of the posterior wall. The cord was excised, the internal oblique and transversalis sutured to Poupart's ligament, and the external oblique closed in the usual manner. Apparently, this strangulation occurred because of the nonresiliency of the internal ring due to the infiltration from the injections.

Lest the question be raised that the proper technic might not have been used or the patient not injected over a sufficiently long period of time, I would like to mention a case operated upon this past year by Doctor Burdick and myself. This patient is a son-in-law of one of the most experienced advocates of this form of treatment in New York City, and over a period of years had had innumerable injections, with no success. This patient, C. C., age 48, was admitted to the Ruptured and Crippled Hospital on May 24, 1943. At operation, the external oblique aponeurosis and conjoined tendon were found to be very fibrotic and adherent. With great difficulty the direct sac was freed and the usual repair, using cotton, was performed. The patient made an uneventful convalescence. He was examined postoperatively at regular intervals. He did not return to work until eight weeks from the date of operation. Four months after his operation he was found to have a recurrence on his right side and the left side gave evidence of great weakness. We feel that this recurrence can definitely be ascribed to his previous injections. The tissues in this patient were in such a fibrotic condition as a result of his injections as to make it impossible for normal healing to take place. It is quite true that recurrences do occur even in patients who have not been injected, but once a patient has been injected the reaction set up in the tissues increases the possibility of a recurrence to such an extent, and according to our previously reported statistics with no hope of cure, we feel it is fallacious to say "that it is all right to inject a hernia as it can always be operated upon later."

During the past two years we have had the opportunity of operating upon a group of 18 patients who had previously had their herniae injected.

Half of this group were found to have indirect herniae, the remainder were direct herniae. Every operation was considerably more difficult than it would have been had the patient not been previously injected. We have not been able to follow all these cases since operation, but of those we have followed we have already found four recurrences. Even granting that all the remaining cases are cured it leaves us with a 22 per cent recurrence rate, which is much too high when one considers that all these patients had simple herniae to begin with. The injections these patients were subjected to accomplished nothing except to increase the difficulties of the operation and definitely increase the recurrence rate following operation.

In the light of our experience upon operating upon these patients, we have come to the definite conclusion that the injection treatment has no place in the treatment of hernia and its use should be condemned.

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# CANCER OF THE FACE

## A CLINICAL AND STATISTICAL STUDY OF 1062 CASES

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MOST PUBLICATIONS on the subject of facial skin cancer recommend radiation therapy, while the importance of surgical treatment is not properly emphasized. The indications for surgical treatment are not clear-cut, and the management of the residual lymph nodes is obscured by the controversy between radiation and surgical dissection.

The purpose of this paper is to summarize the present conception of the subject and to outline the treatment of skin cancer of the face as practiced by the members of the staff of the New York Skin and Cancer Unit of the Post-Graduate Hospital. The study comprises 1062 cases of facial cancer examined and treated during the years 1929–1938.

### FREQUENCY OF SKIN CANCER

The ten-year mortality statistics (1931–1940) of the U. S. Registry[1] shows the appalling number of 33,665 deaths from skin cancer. This figure includes the more malignant varieties of skin lesions, the sarcomata and malignant melanomata which are more difficult to control. With a population composed of more older people today, the incidence of skin cancer will increase, therefore, the subject should become more important. It is estimated that there are several hundred thousand cases of facial cancer in the United States, and the death rate has not improved in the last 15 years.

At the Tumor Clinic of the New York Post-Graduate Medical School and Hospital during the ten-year period of 1929–1938, out of 3,303 lesions of the head, 2,252 cases were diagnosed as malignant tumors. This paper will include only the 1,062 carcinomata of the skin of the face because the cancer of the lip,[2] cancer of the tongue,[3] cancer of the extremities,[4] and malignant melanoma[5] have previously been reported. Further studies on cancer of the mouth, cheek and parotid gland and on the sarcomata are now being prepared and will be presented elsewhere.

### ETIOLOGY OF CANCER OF THE FACE

Although no single factor can be established as the cause of skin cancer the literature mentions: contact with coal tar products, undue exposure to actinic rays or to inclemencies of the weather or to radioactive substances, *etc.*, as contributory factors in predisposed individuals. It is also stated that precancerous dermatoses, hyperkeratosis (senile, arsenical) and xeroderma pigmentosum, unless protected from actinic rays, will degenerate into cancer. In this study, 18 per cent of the patients showed hyperkeratosis as a definite precancerous condition.

Occasionally, malignant degeneration has occurred in neglected, long-standing sebaceous cysts, especially in the older age-group. It was also found in patients with radiodermatitis.

Cancer is less likely to develop in hairy or bearded areas. Where shaving cleanses the skin and the configuration of the face permits thorough washing, malignant lesions are infrequent. Skin cancer is more likely to develop in the creases of the nasal and paranasal areas which are rather neglected during the routine face washing. It is found mostly in areas with abundant sebaceous glands, where the excreted sebaceous material is left on the skin relatively undisturbed by cleansing. Whether the sebaceous secretion serves as a solvent to cancerogenic substances or whether, on such areas, fermentation of the sudorific and sebaceous glands' secretion may be a contributing factor in the development of skin cancer, is not known. Uncleanliness, therefore, is considered a factor in chronic irritation and is productive of cancerogenic agents, whether it is caused by continued exposure to industrial hazards or by accidental exposure in everyday life. This may be a reason for the predominance of facial cancer in the poorer classes with defective hygiene.

### CLASSIFICATION OF SKIN CANCER

Clinically we have found the following subdivision adequate: 1. Basal cell carcinoma. 2. Squamous cell carcinoma. 3. Mixed baso-squamous carcinoma. Further subdivision of the basal cell carcinoma into types, such as solid, cystic and pigmented, is omitted, as it has no therapeutic importance. Special note, however, is made of the infiltrative type of squamous cell carcinoma which is more extensively removed and is more strictly followed-up because of the possible development of regional metastasis.

Changes of basal cell carcinoma to the more malignant mixed baso-squamous cell carcinoma were rarely observed and those seen were among cases of long standing lesions frequently receiving insufficient radiation.

### AGE DISTRIBUTION

Our youngest patient was a boy of 13, with xeroderma pigmentosum of the face on which multiple squamous and basal cell carcinoma has periodically developed. A typical basal cell carcinoma on the right parotid region was observed on a girl of 19. The oldest patient on record was a 93-year-old male with multiple basal cell carcinoma of the face. The younger group with "calcifying epithelioma" at the age of 1–20 is not included in this study as the condition is considered benign.

TABLE I

AGE AND SEX DISTRIBUTION

| Years of Age | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | 80–89 | 90–99 |
|---|---|---|---|---|---|---|---|---|---|
| Basal cell | 2 | 8 | 28 | 78 | 117 | 164 | 81 | 17 | 3 |
| Squamous | 1 | 1 | 4 | 12 | 14 | 33 | 26 | 6 | .. |
| Mixed | .. | .. | 1 | 9 | 7 | 3 | 6 | 2 | .. |

Basal cell carcinoma is most frequently observed after the age of 40

and squamous cell carcinoma after 50 years of age. Males predominated (64 per cent) over females (36 per cent), approximately 2 : 1.

There were 12 cases (1.2 per cent) under 30 (eight males, four females) of which ten were basal cell carcinoma (three on the cheeks, three on the eyelids, three on the nose, one in the parotid region) and two squamous (one on the nose and one on the lip). Both squamous lesions were observed in males.

TABLE II

LOCATION

| | Basal | Squamous | Mixed |
|---|---|---|---|
| Forehead | 42 | 8 | .. |
| Temples | 61 | 12 | 1 |
| Orbital region | 79 | 7 | 7 |
| Nose | 187 | 18 | 5 |
| Cheek | 137 | 25 | 13 |
| Nasolabial fold | 60 | 8 | .. |
| Parotid region | 10 | 3 | 2 |
| Lip (vermilion border not included) | 14 | 2 | .. |
| Chin | 8 | 3 | .. |
| Ears (behind the ear) | 14(10) | 29(1) | 1 |
| Mastoid region | 15 | 1 | 2 |
| | 427 | 116 | 32 |

ANATOMIC DISTRIBUTION

Facial cancer greatly outnumbers other skin cancers. The distribution of the lesions in our cases showed about one-third of the basal cell carcinomas on the nose, usually situated on the bridge, dorsum, base, spreading over the nostrils. Less than 10 per cent were found on the exact midline. The nasolabial folds were thickly involved constituting the smallest, most condensed area around the nose. Frequent sites were the temporal regions, the neighborhood of the lower eyelid, and the area of both inner canthi. They were rarely observed below the line connecting the lobe of the ear with the mouth.

Squamous cell carcinoma predominates on the ear, especially the upper part of the helix. Next to the nose and forehead, the temples and nasolabial folds were involved most frequently (the lesions on the vermillion border of the lips being omitted).

Mixed baso-squamous lesions were found mostly at the temporal, zygomatic, preauricular and nasal regions.

An attempt was made to check the "dysontogenic" origin of these skin tumors. Correlating occurrences of lesions with the embryonic inclusion lines, failed to reveal any direct relationships. Therefore, the statement made by previous authors[6, 7] that basal cell carcinomata develop on the face at the inclusion lines could not be confirmed.

*Duration and Delay of Consultation.*—Table III shows the duration of lesions before consultation for treatment.

Basal cell carcinoma, being generally a very slowly growing tumor, does not alarm the patient and consultation is often delayed for years. The quicker growth of the squamous variety explains the earlier consultation.

To prevent delay of diagnosis, the more frequent use of biopsies are recommended. The need of public education and the distribution of more information do not need to be emphasized as vital factors for earlier treatment.

TABLE III

DURATION OF LESIONS BEFORE CONSULTATION

| Period | Mos. | 3 Mos. | 6 Mos. | 9 Mos. | 1 Yr. | 2 Yrs. | 3 Yrs. | Longer |
|---|---|---|---|---|---|---|---|---|
| Basal | 5 | 40 | 62 | 21 | 87 | 69 | 90 | 70 |
| Squamous | 8 | 34 | 11 | 7 | 13 | 4 | 6 | 2 |
| Mixed | .. | 2 | 8 | 1 | 10 | 3 | 6 | 3 |

### SIZE OF THE LESIONS

The size of the lesion was in direct proportion to the delay in consultation and it varied from 2 mm. to 11 cm. in diameters. Only one-fourth of our patients applied for treatment when the lesions were less than 1 cm.; one-fourth waited until it was over 2 cm. in diameter, and half had lesions between 1–2 cm.

### MODES OF SPREAD AND LYMPH NODE METASTASIS

Skin cancer of the face spreads by direct extension. Basal cell carcinoma practically never metastatizes; in two instances when it was found in regional lymph nodes we were dealing with extensive lesions, and direct invasions rather than metastases had to be considered. Among squamous cell lesions of the face metastases were rare. The impression prevails that the deeply infiltrating squamous lesions breaking through subcutaneous fascia, involving the underlying facial muscles should be observed closely for regional lymph node metastases.

Squamous cell carcinoma of the ear exposed to frequent and repeated trauma involves the regional lymph nodes frequently, similarly to the squamous cell lesions of the vermillion border of the lips. This observation corresponds to that found in melanomata of the ears and extremities[5] which metastasize more readily if traumatized.

Of the 69 surgically treated cases of squamous cell carcinoma of the face followed over a five-year period, we had only three cases of regional lymph node involvement. One lesion was located at the preauricular region and developed metastasis in three months after receiving radium treatment and two others treated with radiation with advanced lesions of the nose. Cervical lymph node dissection was performed six times for squamous cell carcinoma of the face. Only in one specimen was there lymph node involvement which was clinically evident, the original lesion being situated on the nose. A patient developed cervical lymph node metastasis after a long-standing squamous cell carcinoma of the nose developed in a roentgen ray burn. According to our observation, squamous cell carcinoma of the face (unlike ear and lip lesions) rarely forms metastases in the regional lymph nodes, but they may do so if neglected or traumatized.

### SYMPTOMATOLOGY

The most frequent "early" sign of a facial skin cancer was the formation

of a "scaly spot" or a small painless "pimple" which persisted in spite of the application of home and drug store remedies. These lesions increased in size, with a tendency to bleed or ooze when the scab was picked off and showing no tendency to heal.

*Physical Findings:* (1) *Basal cell carcinomas* are round or oval, or polyhedral. At first they are waxy, elevated, indurated nodules, becoming "pearly" on the border and crusted in the center as they extend, with rolled, undulant edge. They may ulcerate or remain nodular, elevated or papillary, while slowly growing and infiltrating into the surrounding skin rather than the underlying tissue. Some tumors are solid or cystic, others superficially expansive, showing epithelization in the center (rodent ulcer). The majority show a scab-covered ulceration. Removal of the scab reveals a grayish, vitreous base, with some oozing or bleeding. Some lesions of long-standing may show extensive involvement, deformity and local destruction, particularly those involving the nose, eye or ear.

(2) *Squamous cell carcinoma* shows a more rapid growth than basal cell carcinoma. The lesion is a spherical, elevated, indurated, scab-covered area, beginning as a well defined, firm, warty nodule which ulcerates in the center as it grows larger. Until ulceration is delayed the lesion is elevated, smooth, spherical. Irregularity was seen rather in the deep, involving variety. The spherical, elevated, superficial type is the most frequently observed. It may be portrayed as a deep, dirty, ragged, irregular, indurated ulceration.

(3) *Mixed or baso-squamous carcinoma* is rarely diagnosed clinically. It appears as a rather irregular, scab-covered, penetrating ulcerated lesion with infiltrative tendencies. It is usually of long duration. It comprises from 6 to 12 per cent of cancer of the face (McKee,[7] 12.6 per cent). From a practical point of view, its treatment is like that of squamous cell carcinoma.

(4) *Multiple Lesions.*—The low percentage of multiple lesions does not confirm the clinical impression which is inclined to be much higher. They were present in 36 cases (multiple basal cell, 25; basal and squamous cell, 3; multiple squamous, 3; and 5 basal and squamous, with mixed carcinoma). One woman with facial cancer also had cancer of the breast. Keratosis was found in association with cancer in a great majority of patients over 60 years of age (18 per cent of the total).

*Recurrence.*—At the time of application 20 per cent of our cases had recurrent lesions, having received previous treatment elsewhere. Table IV shows known previous treatments in recurrent lesions.

## PROGNOSIS

All three types of facial cancer are progressive. Authenticated, spontaneous healing was not observed. As the disease slowly progresses, producing local destruction of tissues, ulceration with secondary infection takes place, which may be followed by oozing, bleeding or hemorrhage due to

erosions of vessels. Basal cell carcinoma is generally a slow-growing tumor lasting for years, though in about 3 per cent it presents more active growth. Squamous cell and mixed, basal squamous carcinoma of the face, if neglected, may metastasize into internal organs causing cancerous cachexia and death.

The outlook is very serious when the neglected or mishandled superficial skin cancer involves underlying bone, the paranasal sinuses or the internal ear, or if the tumor breaks through the outer table of the skull, where the spread is greatly enhanced by the venous pools of the spongy structure of the bone.

TABLE IV

| | Basal | Squamous | Mixed |
|---|---|---|---|
| Radiation | 32 | 12 | 6 |
| Operative | 7 | 3 | 1 |
| Electric needle* | 25 | 5 | 2 |
| Chemical cautery | 3 | 2 | .. |
| Actual cautery | 2 | 3 | .. |
| Silk ties | 2 | .. | .. |
| Total | 71 | 25 | 9 |

* Considering the large number of early skin cancers treated by the dermatologist and general practitioner by desiccation, its effectiveness may be favorably compared with radiation therapy

### ADVANCED CANCER

The reasons for delayed consultation are interesting. Many patients with advanced and neglected lesions told us that they knew they had cancer, but as they considered it an incurable disease no medical advice was sought. Some cases came only when the advanced lesion had become painful. Others stated that they knew somebody who died of recurrence in spite of treatment. The majority came with the history of inadequate treatment, mainly radiation or timid surgical intervention. Others had lost faith in medical efficiency after the lesion recurred, quoting too dogmatic statements of certain cure made by the attending physician at the time of the previous treatment. The importance of the follow-up examination was not explained to the patient.

Some had been treated conservatively for years by the application of ointments, as the correct diagnosis was not made by the attending "physician." In the advanced cancer cases the surgical use of the high frequency current was found highly beneficial for curative and palliative treatment.[10]

### PROPHYLACTIC TREATMENT

Education of the laity and the profession is advocated for prompt diagnosis and treatment of early lesions, which will eliminate the high death rate by skin cancer, which, in our opinion, should be negligible. The information should include differentiation among types of cancers, emphasizing the relatively benign nature of skin cancer. The laity should be instructed that practically any ulceration, if not healed in three weeks by the customary conservative treatment, needs biopsy, serologic examination and that, generally, they should seek early competent medical advice for skin lesions.

Cleanliness should be advocated, and prevention of undue chronic skin irritations by sun and weather and the contact of cancerogenic agents,

especially among older individuals, should be emphasized. In industry it is the responsibility of the supervising physicians to induce proper hygiene. Treatment of keratotic lesions, preferably by electrodesiccation should be widely practiced.

Some long-standing sebaceous cysts have shown malignant degeneration under the microscope. Usually this lesion is well-encapsulated and after customary excision, when the pathologist reports an early cancer with low activity, additional surgery may not be necessary.

*Differential diagnosis* is not difficult to those familiar with the varieties of skin cancer. When senile keratosis is in the early stage of cancerous degeneration it is often necessary to establish a diagnosis by microscopic examination. A small pigmented basal cell carcinoma may be confused with malignant melanoma.

*Fungus infection,* such as actinomycosis, blastomycosis. *Mycosis fungoides* is diagnosed by culture and biopsy. *Leprosy* and *leishmaniosis* were not observed in our service.

*Syphilitic lesions* are confirmed by dark-field and blood examination. The secondary or tertiary lesions may cause difficulty. Syphilitic lesions, also, may be associated with skin cancer. *Gumma* is rare and suspicion is invoked by the positive serum reaction. *Skin tuberculosis* shows variations. Lupus vulgaris, verrucosus and erythematosus of the skin must be considered, and may cause confusion in diagnosis. Therefore, dermatologists should be called more often for consultation in doubtful lesions.

Frequently keratotic or sebaceous nevi are mistaken for basal cell carcinomata. In such cases the etiology and lack of induration or ulceration are helpful. Skin fibromata and verrucae are usually typical lesions and cause no difficulty in diagnosis. A well-performed biopsy often removes a small lesion or repeated if necessary invariably dispels doubt.

## ANALYSIS OF MATERIAL

There were 1062 cases available from the records of the Tumor Clinic with the clinical diagnosis of facial cancer, as shown in Table V.

TABLE V

| | | | |
|---|---|---|---|
| Consultation only | | 119 | 11% |
| Far advanced | | 43 | 4% |
| Treated by radiation | | 381 | 35%* |
| Operated upon | | 519 | 50% |
| Primary lesions | 414 | 80% | |
| Recurrent lesions | 105 | 20% | |
| Plastic reconstructive operations | 147 | 28% | |
| Total | | 1062 | |

* The proportion of patients referred to radiation has been decreased to less than 10% in recent years on account of having prompt and often better cosmetic result after surgical excisions.

## TREATMENT

Skin cancer is treated according to its type, location and degree of involvement. At the Tumor Clinic the outlined routine which follows is closely observed.

All lesions of the face are referred to a diagnostic clinic where a tentative diagnosis is made by the attending surgeon in the presence of the pathologist. Unless too obvious, the diagnosis is affirmed by a biopsy, consisting of the excision of 2 x 5 mm. of tissue from the periphery of the lesion, including normal epithelium. The defect is closed by suture or preferably in case of large ulcerating tumors, the base is desiccated or coagulated by the high frequency currents. Smaller lesions are excised as biopsies.

The majority of cases (at present more than 90 per cent) are referred for surgery and only selected cases are advised to have radiation.

*Radiation Therapy.*—Skin cancer generally responds readily to radiation therapy, but it is usually ineffective in cases of cartilage or bone involvement. In our clinic excisions give prompt and often superior cosmetic results, as compared to radiation, weighing the late effect of radiation, which many times resulted in skin atrophy and teleangiectasia. Some excellent late results were seen after radiation therapy from our Roentgenologic Department which, however, left us unconvinced as to its more extensive use. It may be advocated in lesions over soft-parts as an alternative to surgery. Other cases referred for radiation are the patients with inoperable tumors or patients with an uncontrolled systemic disease, or extreme old age with cardiovascular disease.

The effectiveness of expert radiation therapy with well-defined indication is beyond question. It is advocated more expressly when surgery is objected to, or it may be recommended if no properly trained surgeon is available with experience necessary for cancer and reconstructive surgery. The fine linear scar left by the surgeon is preferable to the whitish, depressed radiation atrophy often surrounded by wide areas of teleangiectasis.

*Surgical high frequency currents* are used in smaller superficial lesions, not exceeding 5 mm. in diameter. Desiccation (sparking) is the method of choice, followed by curettage and desiccation, repeated until all neoplastic tissues are removed. The wound is left dry and does not require a dressing, except powdering, until healing is obtained. This occurs in one to three weeks depending on the size of the lesions and the degree of destruction of epithelial tissues.

A word of warning against coagulation should be said here. It causes deeper destruction and slower healing, and is not recommended for inexperienced hands. We have repeatedly seen cases referred to us after the use of high frequency currents with distressing results. The indolent, slowly healing ulceration caused by inexpert technic was frequently mistaken for a recurrence or persistent tumor.

In some skin clinics desiccation is used in the majority of skin cancers, followed by the application of radium. The reason for this procedure is not easy to understand. If desiccation is properly applied and the tumor is destroyed, there is no need for radiation, but if the operator does not feel that the cancer cells were all removed and wants the remnants to be destroyed

by radiation, why did he use desiccation? High frequency currents have been advocated before radiation to reduce the bulk of tumor.

*Surgical excision* is the choice of treatment whenever there are no contraindications. Excision should be in three dimensions—that is, besides length and width it should include sufficient depth to prevent recurrence. Deep excision around large vessels means careful anatomic dissection, removing the covering fascia of vessels and nerves.

*Wide excision* does not mean unnecessary mutilation but it should be guided by the type and extent of the lesion. With a superficial basal cell carcinoma, an excision with a half-centimeter wide health margin down to the underlying fascia will be sufficient. But if the lesion involves the subcutaneous tissues the underlying fascia also may have to be removed, depending on the depth of the underlying fatty subcutaneous tissues.

To obtain vital information as to the radical removal of the lesion in our clinic it is customary for the surgeon to excise the tumor, mark the specimen with silk sutures and make a diagram indicating from where it was excised. The pathologist in the tumor service, on the basis of such information, is able to report the width and depth of uninvolved tissues around tumors and to state whether the cancerous tissue was all excised. This is considered very valuable information, for if the excision line runs close to the tumor reëxcision may have to be performed.

We wish to emphasize certain areas on the face where the lesions require unusually thorough eradication to avoid troublesome recurrences. The *first* area is the nasolabial fold close to the ala nasi. Tumors here are apt to penetrate early and involve the superior maxillary bone and antrum and, if recurrent, even by radical surgery, are difficult to control. Tumors of the nose involving the septum and ethmoid cells are rather troublesome and open treatment for a long period is advisable. Extensive involvement of such areas is not always hopeless, however, and occasionally a cure results.[8] Our fatal cases belonged to these groups as we lost five in spite of extensive interventions. From the practical point of view, all skin cancer is treated the same way. The rule of wider excision of squamous cell cancer does not hold in the superficial forms and radical removal of the infiltrating type is the same as in the similar type of basal cell cancer; they both must be adequately excised. In regard to squamous cell and mixed baso-squamous cell lesions, it is unfortunate that no rules at present may be formulated as to which lesion will metastasize; although the clinical impression indicates that trauma favors metastasis. The indications for lymph node dissection were previously discussed. The lack of mortality and morbidity of lymph node dissections for skin cancer in the past 15 years should prompt more intervention in doubtful cases.

*Squamous cell carcinoma of the ear* deserves special study as it is characterized by increased tendency to metastasize to the cervical lymph nodes. Of the 25 carcinomata of the ear, our record shows 20 squamous (80 per cent) and five basal cell lesions (20 per cent). The basal cell lesions all

survived the five-year period (one with persistent tumor is alive after seven years). Among the 20 squamous cell carcinomas, two were far-advanced, and in these only biopsy was performed before radiation was given, without benefit. Eighteen were operated upon, with wide excision, frequently consisting of ablation of the ear followed by lymph node dissection. In six lymph node dissections with palpable cervical lymph nodes, involvement was found twice, and one of these patients survived the five-year period. In the remaining cases lymph node dissections were either refused or not performed on account of early lesions. Of the 20 patients with squamous carcinoma of the ear, seven died of general metastases and four were lost from follow-up, nine being alive and well after five years (45 per cent).

This limited number of cases shows the danger of procrastination in squamous cell cancer of the ear. To improve results, even in cases of nonpalpable lymph nodes, routine cervical lymph node dissection should be recommended, with the exception of early noninfiltrating lesions.

### TREATMENT OF ADVANCED CANCER

In the more advanced or recurrent lesions we practice extremely wide excision or preferably destruction of the tumor by electrocoagulation. This method has certain advantages. It facilitates the recognition of the coagulated tumor and, by contrasting it with the coagulated normal tissue, more thorough eradication is assured. After the tumor has been thus removed, we practice the excision of the remnant of the coagulated tissues with an adequate healthy margin to prevent recurrence and to eliminate tissues damaged by the current which might complicate wound healing. Such procedures gave us gratifying results and control of advanced and repeatedly recurring cancers after radiation or simple surgical excisions had failed.

In the presence of advanced facial cancer, it may be advisable to discuss with the patient the possibility of a recurrence and the necessity of further treatment and follow-up.

### ANESTHESIA

Excisions are preferably undertaken under local or block anesthesia. Tumors requiring extensive operations and reconstruction are also preferably operated upon under novocaine block. Spreading of skin cancer by the injection of novocaine into the neighboring tissues was not observed.

Sufficient skill acquired in performing novocaine local and block anesthesia will leave less and less cases of radical operations and regional lymph node dissection for general anesthesia, thus cutting down morbidity and mortality.

### FOLLOW-UP EXAMINATION

In order to detect early recurrence or small new lesions, a regular follow-up examination is imperative. The follow-up period at intervals of one to four months may be limited to three to five years in cancer of the face, but should preferably be for lifetime at yearly intervals.

Patients kept on our follow-up for many years had the benefits of early and simple treatment in cases of the development of new lesions, or occasional recurrence.

*Recurrent Lesions.*—The high percentage of recurrences (20 per cent) among our cases first examined shows how inadequate is the treatment generally for facial cancer. The recurrences frequently require more extensive operations often followed by reconstruction.

Among our primary-operated lesions there were ten (2 per cent) recurrences. In five rather early cases excision was done in the clinic by the resident. Our attending staff operated upon the other five cases, in which recurrences were noted at the nasal, nasolabial, auricular and orbital regions, with bone involvement.

In several cases more than one operation was necessary. Five patients required two operations within four years; two had three operations within two to three years, and one patient had five operations within three years, with the result of arresting the disease.

Cases with persistent cancer, when the palliative operations consisted of electrosurgery, are not included among recurrent lesions. In such cases the aim is to prolong life and alleviate suffering, regardless of statistical results.

## RECONSTRUCTION

In infiltrating lesions, large defects result from the wide excision in three dimensions necessitating correction by reconstructive plastic surgery. Such extensive removals, essential in cancer surgery, regardless of the ensuing defect, often constituted a problem for reconstruction, especially if eyelids, nose or ear were involved. Where complete eradication was possible, immediate plastic reconstruction was done.

If the paranasal sinuses alone were involved and eradication even by electrocoagulation was doubtful, the wound was left open for later reconstruction. When monthly biopsies of suspicious areas had been negative for about six months to two years plastic reconstruction was performed. In general, we are definitely not in favor of making an invalid of a man who has had cancer of the face and of watching unduly for recurrences in cases where radical extirpation is feasible.

Plastic reconstruction in 147 cases consisted of Thiersch-Ollier skin graft in 48 cases. Pinch-grafts were made in two cases of large infected defects, full-thickness grafts in 47 cases, and repair by skin flaps in 50 cases. There were two recurrences after orbital and nasal plastic reconstructions were completed.

Large defects in elderly individuals were usually covered by skin grafts. Better cosmetic results with occasional minor complications were obtained by using full-thickness graft from behind the ear, upper eyelid or neck, rarely from abdomen.

In more extensive operations skin flaps were used which were lined by skin graft or double flaps when mucosa of the nose and cheek, or con-

TABLE VI

ANALYSIS OF RESULTS IN 519 PATIENTS WITH CANCER OF THE FACE OPERATED UPON

| | | |
|---|---|---|
| Total number of cases operated upon | 519 | |
| *Basal Cell Carcinoma:* | | |
| Total number of cases operated upon | 416 | 80.3% |
| Operative mortality | 0 | .0% |
| Died of other disease, no recurrence | 21 | 5% |
| Died of persistent or recurrent disease | 7* | |
| Alive with persistent or recurrent disease | 5 | 2.9% |
| No follow-ups | 85 | 20.4% |
| Number of basal cell cancer cases under follow-up, less lost and dying from other causes | 310 | |
| Alive and well after five years | 298 | 96.1% |
| Primary: Number of cases followed five years, less those lost and dying from other diseases | 229 | |
| Primary: Alive and well after five years | 227 | 99.0% |
| Recurrent: Number of cases followed five years, less those lost and dying from other diseases | 81 | |
| Recurrent: Alive and well after five years | 71 | 87.6% |

* Dying one to four years after palliative operation and radiation failed.

| | | |
|---|---|---|
| *Squamous Cell Carcinoma:* | | |
| Total number of cases operated upon | 69 | 13% |
| Operative mortality | 1† | |
| Died of other diseases, no recurrence | 8 | |
| Died of persistent or recurrent carcinoma | 9 | |
| Alive with disease at end of five years | 0 | |
| No follow-ups | 17 | |
| Total known cases under follow-up, less lost and dying from other diseases | 44 | |
| Alive and well at end of five years | 34 | |
| Number of squamous carcinoma of face follow-up | 24 | |
| Number of squamous carcinoma of face died of disease | 3 | |
| Number of squamous carcinoma of face alive and well, five years | 21 | 87.5% |
| Number of squamous carcinoma of ears | 20 | |
| Number of squamous carcinoma died of disease | 7 | |
| Number of squamous carcinoma, no follow-up | 4 | |
| Number of squamous carcinoma of ear well after five years | 9 | 45.0 % |

† Wide excision and lymph node dissection for an extensive recurrent lesion.

| | | |
|---|---|---|
| *Mixed Baso-squamous Cell Carcinoma:* | | |
| Number of cases operated upon | 34 | 7.5% |
| Operative mortality | 0 | |
| Died of other diseases, no recurrence | 1 | |
| Died of persistent or recurrent disease | 3 | |
| No follow-ups | 10 | |
| Number of cases followed five years, less lost and dying from other causes | 24 | |
| Alive and well after five years | 21 | 87.5% |

| | | |
|---|---|---|
| *Ten-year Results:* | | |
| Operated upon more than ten years ago | 205 | |
| No follow-up | 73 | |
| Died of other diseases without recurrence | 22 | |
| Died of persistent or recurrent carcinoma | 12 | |
| Ten-year follow-up, without recurrence | 98 | |

| | Basal | Squamous | Mixed |
|---|---|---|---|
| Total follow-up | 88 | 13 | 9 |
| Ten-year results | 84 | 7 | 7 |
| Per cent of arrests | 84% | 53.8% | 77.7% |
| Died | 4 | 6 | 2 |
| Primary | 98% | | |
| Recurrent | 88% | | |

junctiva had to be formed. Skin flaps consisted of cheek flaps, fronto-temporal flap, and were obtained from neck or scalp.

In recent years only full-thickness grafts and skin flaps have been used for reconstruction, with better cosmetic results.

## RESULTS

The analysis of the material from the New York Skin and Cancer Unit of the Post-Graduate Hospital from the period of 1929–1938 inclusive, shows the following figures (Table VI):

The high death rate from intercurrent diseases is comprehensible when dealing with an advanced age-group.

Many of our cases on the follow-up were lost, as we receive our patients from a highly unsettled group of people in New York City, and, besides, many expressed the desire not to be followed-up after various periods.

Seven patients with basal cell carcinoma were found alive but with disease at the end of five years; these all died later. One case of adeno-carcinoma of the nose was reported with multiple recurrences and dying of general metastasis two years after palliative electrocoagulation of the cheek and nose.

Among those dying of persistent and recurrent cancer in the ten-year group were four cases of basal cell, six of squamous, and two of mixed carcinoma. The original lesions were located as follows: two on the nose, three on the nasolabial folds, three on the temporal region and four on the forehead-orbit.

## SUMMARY

1. A clinical and statistical study of 1062 basal, squamous and baso-squamous carcinomata is presented.

2. The "dysontogenic origin" of basal cell carcinoma could not be confirmed, but, rather, uncleanliness is stressed as a contributory factor for the development of facial cancer.

3. It was found that on the average there was about a year's elapse with basal cell carcinoma and about three months with squamous cell carcinoma before consultation.

4. All facial cancer spreads by direct extension.

5. Clinically, basal and squamous cell carcinoma can generally be differentiated by the experienced eye.

6. Since basal carcinoma does not metastasize and squamous cell carcinoma of the face only rarely, routine lymph node dissection is not recommended. Frequent metastases to the regional lymph nodes were found in squamous cell carcinoma of the ear. Therefore, radical surgery with frequent lymph node dissection is advocated.

7. All lesions were progressive. No spontaneous healing was observed.

8. Twenty per cent of the cases were recurrent lesions with the history of an inadequate previous treatment and in those cases it was gratifying to find equally good results with control by surgery.

9. The indications for electrodesiccation and radiation therapy are discussed. Surgical treatment is advocated in preference as it gives higher percentage of arrest and often superior cosmetic results.

10. Advanced cases were also treated by radical surgery, preferably using the high frequency currents. It resulted in some arrest or palliation of the disease in the majority of cases.

11. Reconstruction should be made preferably at the time of the operation, although in some cases it is wiser to postpone the closure of the defect for a longer period.

12. The percentage of five- and ten-year arrests of the primary and recurrent lesions are given.

13. Follow-up examinations are advocated as the key to successful treatment and to scientific studies.

14. Although there is still an unduly high percentage of mortality from skin cancer, adequate treatment by qualified surgeons should materially reduce it in the future.

The author wishes to express his thanks to Dr. Carl Eggers for the guidance and constructive criticism in this material, and wishes to pay tribute to the members of the Surgical Staff, including Colonel William F. MacFee, Colonel Robert H. Kennedy and Lt. Col. Herbert W. Meier, now in the armed forces, whose splendid work can be measured only by the results.

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# TRAUMATIC ANEURYSM OF THE FIRST PORTION OF THE LEFT VERTEBRAL ARTERY

CASE REPORT

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ANEURYSMS of the cervical (extracranial) portion of the vertebral artery are seldom encountered. In the collected literature of the subject only Cattolica (Perrig)[1] and Küttner[2] have described more than one case. Nevertheless, two fine reviews of traumatisms of the vertebral artery have been recorded, one by Matas,[3] in 1893, the other by Perrig, in 1932. Matas' lucid and comprehensive exposition tabulated 22 cases of wounds of the cervical portion of the vertebral artery, of which 19 died as a consequence; and 20 cases of aneurysm, of which only six survived, one a case of his own. Perrig, with the reports of World War I from which to draw, was able to collect 40 cases of traumatism and 60 cases of extracranial aneurysm. He appended to his discussion abstracts of all these cases. In the group of aneurysms only 48 impress me as *bona fide* cases of traumatic aneurysm of the cervical portion of the vessel, four cases failing to indicate if trauma was a factor, and eight giving no history of trauma. A more detailed analysis of the abstracts shows that of these 60 cases, traumatic or otherwise, the aneurysm arose in the first (extraspinous) portion in six instances, while in another eight cases this was the probable site. The second (intraspinous) portion of the vessel was clearly, or probably, involved in 28 instances. In the remaining 18 cases the affected site could not be ascertained. At least 28 of the 60 cases died as a direct consequence of the lesion, or its treatment. Of the remaining 32 cases, cures were recorded in 19, improvement in one, and recurrence in one, while in 11 cases the outcome was not indicated.

Aside from these in the reports of Matas and Perrig, other case reports have been made by Giglio,[4] Drügg and Siegmund,[5] Barraud,[6] Spath,[7] Ogilvie,[8] and Meurer.[9] In each of these cases the aneurysm arose from the intraspinous or suboccipital segment of the vessel. Three were traumatic in origin, and cures were effected by surgical means in these instances. Barraud's case was diagnosed at autopsy, while that of Drügg and Siegmund succumbed to postoperative infection. The outcome in Ogilvie's case was not recorded. The American literature includes only the three mentioned by Matas, his own and those of Stone,[10] and Fenger (Matas[3]).

Nearly all cases of aneurysm of the cervical portion of the vertebral artery result from traumatism, either by gunfire or by stabbing. That the vertebral artery is seldom subject to direct trauma is understandable by a consideration of its location. It arises as the first branch of the ascending

portion of the subclavian artery, just medial to the anterior scalenus muscle. Ascending obliquely along the lateral margin of the longus coli, it enters the foramen of the transverse process of the sixth cervical vertebra. This extraspinous portion of the artery is about one and one-half inches long. Its great depth can be realized from the list of the important structures which overlie it—the thyrocervical trunk, the carotid artery, the internal jugular vein, the omohyoid muscle, the sternocleidomastoid muscle, and the transverse portion of the external jugular vein. The location of these structures lessens the chances of an isolated injury to the vertebral artery. Perhaps these injuries have occurred more frequently than reported, but were unrecognized because damage to the other vessels caused the subject's rapid exitus or drew the observer's exclusive attention. The intraspinous portion of the artery begins at the transverse process of the sixth cervical vertebra, ascends through the foramina of the transverse processes of the proximal vertebras, runs toward the median line in the groove upon the upper surface of the posterior arch of the atlas, whence it enters the skull after penetrating the atlanto-occipital membrane. We are not concerned here with the intracranial portion, except to mention that it joins with its fellow of the opposite side to form the basilar artery. This anastomosis will be mentioned later in a consideration of the treatment. It might be expected that injury to the second portion of the vessel would be prevented by the vertebral transverse processes, but this is not always the case, for the traumatic agent may have enough room to enter between the transverse processes (the intertransverse spaces are sometimes wider than the transverse processes) moreover, several cases have resulted from comminuted fractures of the transverse processes. The additional fact that this area of the neck, especially the suboccipital region, is more accessible to trauma perhaps explains a greater frequency of aneurysm in the second than in the first portion of the vessel.

The preoperative or premortem diagnosis of aneurysm of the cervical portion of the vertebral artery is most difficult to make. The appearance of a pulsatile swelling following a trauma to the neck is generally deduced to occur in connection with the larger vessels. This mistake has been so frequent that ligations of the common carotid artery were erroneously performed in well over half the cases.* In only two of Perrig's case abstracts was the diagnosis suspected prior to operation. In one, the presence of a fracture of the transverse process with the bullet *in situ* was the lead, while in the other location of the swelling in the atlanto-occipital region presented the clue to the surgeon. In Meurer's case the diagnosis was accurately made by arteriography; after failure to demonstrate the sac by carotid arteriography, injection directly into the sac established its origin.

In my case the usual error in diagnosis was made, and it was not until the second operation that the true nature of the lesion was realized. Since

* Matas has emphasized the importance of avoiding this error by pointing out that ligation of the common carotid artery throws the added strain of the anastomosing circulation on the vertebral artery, which aggravates the lesion.

previous reports have not, or could not, always indicate the exact site of origin of the aneurysm, it can be only conjectured that this case represents anywhere from the seventh to the fifteenth reported case of aneurysm of the extraspinous portion, and from the third to the fifth cure obtained in this type of case.

**Case Report.**—W. M. H., female, age 27, was seen in the receiving room of the Homer G. Phillips Hospital at 7:30 P.M., May 15, 1944, shortly after she was stabbed with a thin-bladed pocket knife during an altercation. Her appearance indicated that she had lost considerable blood. A three-quarter-inch linear vertical laceration was present on the left side of the neck four inches below and anterior to the mastoid process, overlying the middle of the sternomastoid muscle behind its anterior border. Blood pressure 120/80; temperature 98.6° F., pulse 88; respirations 22. A loud to-and-fro machinery murmur was heard over the aortic area. At 8:00 P.M. the skin was sutured, and she was admitted to the hospital ward because the surgeon was not satisfied that the bleeding

FIG. 1.—Appearance of the aneurysmal swelling fourteen days after the stabbing. The healed stab wound is visible.

was controlled. At 10:00 P.M., on account of continued "spouting" of blood, the wound was reopened, and an unsuccessful attempt made to locate the bleeding point; following which the wound was left open and a pressure dressing applied. At 11:00 P.M. the W. B. C. was 7,200; R. B. C. 2,800,000, and hemoglobin 58 per cent. On May 17, there being no further bleeding, secondary closure of the wound was effected, and the patient was discharged from the hospital the following day.

She was readmitted, May 29, 1944, a pulsatile mass having formed at the site of the wound, which had healed *per primam.* The swelling was first noticed about five days after she left the hospital, and steadily increased in size. Concommitantly, she became aware of "pounding" in the neck and "roaring" in the ear, which would sometimes keep her awake at night. In her past history it was noted that, in 1936, she received incomplete antiluetic therapy, and that, in 1939, she had sustained a laceration in the right suprasternal region of the neck from a kick, the scar of which was still visible. Her recent laceration was well healed. Underlying and inferior to it, approximately three inches below the angle of the jaw, was a bulge about two inches in diameter and elevated

an inch above the surrounding skin surface (Fig. 1). It was visibly as well as palpably pulsatile, and a vigorous thrill was present. Loud systolic and diastolic bruits were heard, the former phase being the more prominent. The mass could be almost completely compressed, but without appreciably diminishing the thrill. A loud machinery murmur could be heard in the aortic and pulmonic areas, and as the neck was approached this merged into the bruit described above. The blood pressure of the left arm was 124/85, that of the right 128/86. It was thought that we were dealing with an arteriovenous aneurysm between the left common carotid artery and the left internal jugular vein, or with a saccular aneurysm of the common carotid artery. Laboratory data: W. B. C. 7,400; R. B. C. 3,500,000, hemoglobin 78 per cent; uranalysis negative; Kahn negative; N. P. N. 18; total proteins 6.33, A/G ratio 1.6.

*First Operation.*—June 3, 1944: Under intravenous pentothal-sodium anesthesia (88 cc. of 2.5 per cent solution were used), an incision four inches long was made over the middle of the left sternomastoid muscle parallel with its anterior border, the upper end reopening the healed stab wound. After division of the deep cervical fascia and posterior retraction of the sternomastoid muscle, a forcibly pulsating, thin-walled aneurysm was exposed. The dissection had as its initial aim exposure of the common carotid artery and the internal jugular vein. They were found to lie anterior and medial to the aneurysm, with which they were seen to have no connection. An attempt to isolate completely the sac met with failure because of its dense adherence to the surrounding muscles and fascia. It was determined, however, that the wall extended inferiorly at least to the level of the clavicle, that its medial and posterior aspects were much deeper than the dissection, and that the aneurysm was larger than was apparent on external examination. It was surmised that the aneurysm originated in the subclavian artery. The operation had already lasted two and one-half hours, and, being somewhat indecisive as to further procedure and hesitant to subject the patient to a protracted exercise, I decided to abandon further surgical measures for the time being. The deep cervical fascia was tightly repaired to compress the aneurysm, and the wound closed.

*Postoperative Course.*—This was uneventful; and the incision healed *per primam.* However, the visible aneurysm increased to twice its preoperative size, and there was a parallel augmentation of the roaring sensation in the head and neck and in the resultant sleeplessness. Accordingly, a second operation was advised, and this time exposure of the subclavian artery was contemplated. The laboratory data at this time was not significantly altered from that previously reported.

*Second Operation.*—June 26, 1944: Under intravenous pentothal-sodium anesthesia (75 cc. of 2.5 per cent solution were used), an incision was made along the anterior margin of the left sternomastoid muscle about three-quarters of an inch anterior to the healed incision, the upper end reaching to the same level, and the lower end extending over the left sternoclavicular joint and along the left border of the sternum for one and one-half inches. A second three-inch long incision along the lower border of the clavicle was made to meet the first incision. The common carotid artery and internal jugular vein were isolated as in the previous operation. During the dissection of the skin flaps the thin adherent wall of the aneurysm was accidentally opened causing an active outpouring of arterial blood. Insertion of the index finger fortunately controlled the blood loss and afforded palpation of the inside of the sac. This was found to extend upward to the level of the transverse process of the fourth cervical vertebra, to lie medially and posteriorly against the vertebral column, and to extend below behind the clavicle. An internal, fairly rigid, ovoid opening one-half inch in its widest diameter, could be palpated against the transverse process of the sixth cervical vertebra, but the finger could not be inserted sufficiently through the opening to ascertain the genesis of the sac. Early isolation of the subclavian artery now seemed imperative. An assistant assiduously kept his finger inserted through the rent for the control of bleeding. The sternomastoid muscle was disjoined at the clavicle and sternum, the omohyoid was divided lateral to its central tendon, and the left sternohyoid muscle was severed at

the upper margin of the sternum. The medial fourth of the clavicle and the upper one and one-half inches of the left half of the sternum were resected. The internal jugular vein was divided near its confluence with the subclavian vein. Lateral retraction of the anterior scalenus muscle then permitted the exposure of the ascending portion of the subclavian artery. When no connection between this vessel and the aneurysm could be found, it was concluded that the vertebral artery was the affected vessel (Fig. 2). Dissection along the inferior margin of the sac exposed the origin of the vertebral artery, arising from the medial aspect of the subclavian as its first branch. Practically at its

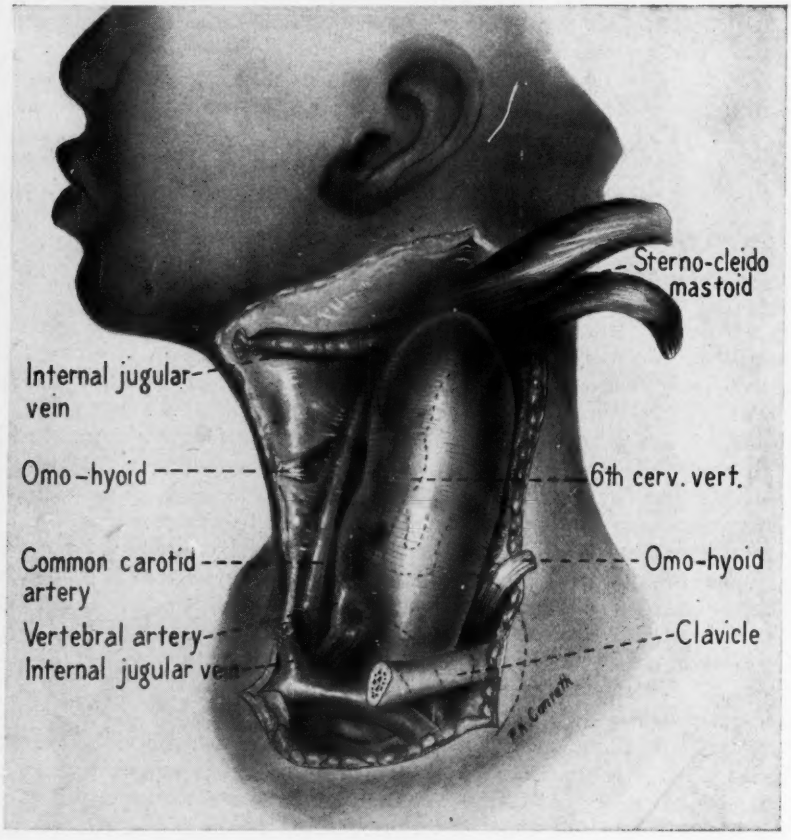


FIG. 2.—Aneurysm of the extraspinous segment of the left vertebral artery. The lower end of the sac is displaced laterally and posteriorly to demonstrate the origin from the vertebral artery. The drawing is largely schematic because of the complexity of structures in the vicinity and because the exact limits of the sac were not determined at operation.

origin the vertebral artery merged with the aneurysm wall. Further proof that we were dealing with an aneurysm of the first portion of the vertebral artery could be deduced by bimanual palpation—the index finger of the right hand in the sac, that of the left outside. When the subclavian artery was compressed, the pulsation and thrill diminished. Believing that occlusion of this vessel would control the blood flow, the vessel was doubly ligated with heavy linen in its first portion, proximal to the origin of the vertebral artery.* This promptly caused cessation of the radial pulse and blood pressure of the left arm, but the extremity remained warm during the remainder of the operation. Our trust

* Halsted[11] has shown that ligation of the subclavian artery in its first portion may be performed without depriving the upper extremity of its arterial supply.

that this would control the blood flow was "jolted" upon removal of the digit, which permitted almost as much blood to flow as before the ligation. The small segment of vertebral artery between the subclavian artery and the sac was then ligated and divided, but this also did not appreciably alter the blood flow or the thrill. It was, accordingly, concluded that the aneurysm was being replenished by the distal collateral circulation. A plan to enlarge the opening originally made into the sac for the purpose of attempting an endo-aneurysmorrhaphy had to be abandoned because the field became obscured with blood before adequate exposure could be obtained. Distal ligation of the vertebral artery was out of the question from this approach and at this stage. It was, therefore, decided to tamponade the sac with live muscle transplants. Three blocks of skeletal

FIG. 3.—Appearance of the neck three months after operation. The swelling has disappeared as a result of obliteration of the aneurysm.

muscle excised from the sternomastoid and pectoralis major muscles were packed so as to fill tightly the entire sac. Care was taken to insert the first muscle transplant to occlude the opening at the transverse process of the sixth vertebra. This caused an immediate cessation of the pulsation and thrill. The rent in the sac was then closed over the transplanted muscle with two layers of interrupted cotton sutures. The wound was closed without drainage, no attempt being made to suture the divided muscles. The duration of the operation was four hours and forty minutes; and with the aid of 1500 cc of 5 per cent glucose and 1000 cc. of whole blood intravenously, the pulse and blood pressure were maintained at a constant level.

*Postoperative Course.*—This was quite satisfactory. The pulse rate rose to 132 eight hours after the operation, but dropped to normal by the second day. The temperature rose to 102° F. 24 hours after operation, but this, likewise, promptly returned to normal. The blood counts and chemistry were within normal limits on June 29. The only complication was the collection of about 5 cc. of turbid yellow fluid, which, on July 5, was expressed from a subcutaneous pocket at the middle of the vertical incision. At this time no pulsation or bruit was present, although the firm obliterated aneurysm swelling was readily seen and felt. The blood pressure and radial pulse were still absent from the left upper extremity. There was no complaint of roaring in the ear and sleeplessness.

*Subsequent Course.*—The patient was discharged from the hospital on July 12, the wound having completely healed. The aneurysm swelling had appreciably diminished. Through some of the postoperative course there were complaints of aching pains in the left upper extremity and shoulder, but aside from a slight weakness of this extremity the muscular control was quite satisfactory. The to-and-fro murmur heard in the aortic region from the date of her orginal admission had, likewise, disappeared—proving that this sound had been transmitted from the neck.

By August 11, the swelling had completely vanished (Fig. 3), and no pulsation or bruit could be detected. No deformity of the neck due to the severance of muscles or resection of bone was present, and motion of the head was unlimited in all directions. The left radial pulse was barely perceptible, but no blood pressure reading could be obtained from the left arm. Re-examination on October 13 showed no appreciable change. The only complaint on this date was an occasional aching pain in the left shoulder.

Discussion.—Any discussion of the treatment of aneurysm of the cervical portion of the vertebral artery should be prefaced by the assertion that no one has had sufficient experience with these cases to design a dependable approach. Nor does expertness in the management of aneurysms elsewhere necessarily condition the surgeon for proficiency with the unique anatomic considerations here. We have already mentioned the depth of the vertebral artery and the complexity of structures guarding its access. The singular course of the vessel within the vertebral transverse processes adds to the intricacy of approach as well as to the shaping of the contour of the sac, and this is particularly true when the aneurysm arises from the intraspinous portion. Still another unique feature is the spacious anastomosis with its fellow vessel of the opposite side and its communication with the circle of Willis. It is on account of this feature that proximal ligation proved futile in controlling the flow of blood in my case. Both proximal and distal ligation, as advocated by Matas, would seem to be a highly desirable procedure, but has been successfully acomplished in only three cases. That the proximal ligation can be performed has been demonstrated not only in a number of the cases under discussion, but also in cases of epilepsy, where the operation was performed with some frequency toward the end of the last century. The achievement of distal ligation should be feasible if we relinquish the thought of attempting it low in the neck, and approach the vessel, if necessary through a separate incision, posteriorly below the occiput. However, it must be admitted that fulfillment of this objective is usually both hazardous and arduous. Moreover, it is not certain that double ligation would assure a complete and permanent obliteration of the aneurysm, since the existence of other collateral circulation has been noted (Küttner).

All things considered, it would seem that cure could be better assured if the aneurysm sac was directly approached. As with aneurysms elsewhere, extirpation of the sac with double ligation would be the choice, but the probability of achieving this in any but the most favorable circumstances is remote. A variety of other less radical procedures have been tried, including injection of irritants and sclerosing media, electropuncture and electrolysis. Endoaneurysmorrhaphy has been employed only in Spath's case. The method

which has appealed to the judgment of most operators is treatment by incision and tamponade. That this method was oftentimes employed may be a reflection on the frequency with which the surgeon found himself in a desperate predicament. There is scarcely anything surgically so instinctive as tamponading an exsanguinating operative site. Of the 16 cases in which the aneurysm was opened (usually accidentally) and packed, cures were obtained in ten—a relatively high percentage. In most cases the packing consisted of gauze impregnated with antiseptics and astringents; in several cases ligation of the proximal vessel was an adjunct.

Küttner introduced the utilization of muscle transplants as the tampon in two of the three cases which came under his observation. In each instance proximal ligation failed to control the blood flow. In one, distal ligation was attempted but could not be effected. Free muscle transplants consisting of about 15 to 20 small fragments derived from the adjacent muscles were, accordingly, packed through the incised opening into the sac, the wall of which was sutured tightly over the transplants. The successful outcome in both these cases prompted him to suggest this method as the treatment of choice, and the gratifying result of my case would seem to substantiate his recommendation. It is apparently not necessary to use large numbers of small transplants. The size of the grafts need only be limited by the size of the opening through which they are to be inserted. The question naturally arises as to whether proximal ligation is a necessary adjunct to the success of this procedure. Of course, no unequivocal answer can be forthcoming. Nevertheless, it is apparent that this, not too risky, ligation might decrease the blood current sufficiently to permit adherence and organization of the transplant.

The use of pedicled and free muscle transplants in aneurysms of the subclavian and femoral arteries has been described by McNealy and Shapiro.[12] They demonstrated experimentally, that muscle transplants adhere to the intima by the development of a proliferative endarteritis, and that recanalization does not occur. Previously, I had the opportunity to employ a pedicled muscle transplant to obliterate an aneurysm of the posterior tibial artery. The present case is additional evidence that this is a feasible, as well as a desirable, method of managing those arterial aneurysms not requiring restoration of the blood flow, and whose extirpation or obliteration by other means would proffer inordinate hazards. Since the vertebral artery is of medium caliber, the use of muscle transplants in aneurysms of this vessel would seem to offer a better hope for cure than in those of larger vessels.

SUMMARY

A case of aneurysm of the first portion of the left vertebral artery resulting from a stab wound is described. A complete cure resulted from the use of autogenous muscle transplants directly into the sac, after proximal ligation failed to control the flow of blood.

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# STRICTURE OF THE FEMALE URETHRA WITH LYMPHOPATHIA VENEREA

## LYMPHOGRANULOMA INGUINALE

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IN RECENT YEARS gynecologists and urologists are becoming more and more interested in strictures of the female urethra. Many authors state, that such strictures are rare, others say, that the frequency and importance of this ailment are not enough emphasized. We believe that strictures of less degree are not infrequent, but the more severe type, as illustrated by the case to be reported, is very rare.

**Case Report.**—Mrs. M. B., colored, age 41, was admitted to the Gynecological Service of Dr. William R. Nicholson, June 11, 1944, complaining of great difficulty in voiding her urine. She states that ten years ago on a very cold day she had to wait for a trolley car a very long time, and arriving at the factory she felt cold "up to the navel." She was unable to pass urine, and on her way home she started dribbling and felt wet. Her family physician could not pass a catheter and ordered a medicine which improved the condition temporarily. Since this time the patient has been forced to be under medical care.

The patient gave birth to one child 24 years ago, and had three miscarriages in the last five years. Menstruation started at age 14, was regular every 28 days, lasting 3-5 days, with moderate flow and slight cramps on the first day. As a child she had measles and mumps but no history of scarlet fever or diphtheria. In 1940, a urethral stricture was treated by dilatation. In 1943, a bilateral salpingectomy and appendicectomy was performed.

*Physical Examination.*—Female colored patient, in general good condition. Blood: R. B. C. 3,860,000, 63 per cent hemoglobin; W. B. C. 9,400, 68 per cent neutrophiles, 2 monocytes, 30 per cent lymphocytes.

The vagina and uterus were normal. No abnormal resistance could be detected in the pelvis. The urethra was extremely narrowed and only allowed the passage of a filiform ureteral catheter, by which the greatly overdistended bladder was evacuated. Wassermann reaction was negative.

The diagnosis of a tight stricture of the upper half of the urethra was self-evident, but the etiologic explanation was at first difficult.

A study of the world literature shows that a great number of diseases can cause stricture of the female urethra. Wynne[57] classified strictures as traumatic, inflammatory, neoplastic, congenital, senile and unknown.

In the herein reported case, injury during childbirth can be excluded as the *partus* was 24 years ago and the first onset of urinary retention ten years ago, therefore, 14 years after the delivery. There is also no history of accidental injury, burns, scalds, previous operations or the application of strong caustics, pointing to a traumatic cause.

Inflammatory diseases causing urethral strictures in the female as syphilis, tuberculosis and chancroid are excluded as causal factors, because of the

absence of positive specific reactions in this patient. The history also does not show diseases which sometimes cause ulceration of the vulva, such as scarlet fever and diphtheria.[39, 43] Gonorrhea, the most common cause of urethral stricture in the male, but a very rare cause in the female, can not be considered as etiologic factor since gonococci were never found. No benign or malignant new growths, responsible for the urethral stricture,[26, 35] were in evidence. A congenital etiology[19, 31, 51] is out of the question as patient had the first symptoms at the age of 31.

The only positive finding in the herein reported case was a *positive Frei test,* which proves that the patient suffers from lymphopathia venerea. Whether or not this disease is a possible etiologic factor in stricture formation of the female urethra will now be considered.

Before we discuss this question, it seems to be necessary for the sake of clearness, to discuss the different types of lymphopathia venerea, together with the possibility of the involvement of the urethra and the pathology of stricture formation.

## LYMPHOPATHIA VENEREA AND THE INVOLVEMENT OF THE URETHRA IN THIS DISEASE

The different names given by various authors to lymphopathia venerea have not contributed to clear up the knowledge of this disease. Thus some authors suggested "subacute inguinal lymphogranulomatosis",[46] others named it "climatic bubo."[18, 19, 42] It has also been given such names as "the fourth venereal disease," "tropical bubo,"[55] "subacute inguinal poradenitis," "strumous bubo," "subacute inguinal lymphadenitis," "inguinal poradenitis"[6] "inguinal adenopathy," "pestis minor," "granuloma venereum"[5] and "nontuberculous granulomatous lymphadenitis." The term lymphogranuloma inguinale seems to be used most extensively in European literature, though it must be emphasized *that this term really designates an entirely different condition from granuloma inguinale.* To distinguish between these diseases we prefer, and will use, *lymphopathia venerea* instead of lymphogranuloma inguinale. *Lymphopathia venerea is a disease of the lymph channels and of the nodes,* due to a filtrable virus and gives a positive Frei test. *Granuloma inguinale involves the skin and subcutaneous tissue,* and is due to the Donovan bodies.

The different forms, in which lymphopathia venerea occurs, and its different manifestations in the two sexes, are of the utmost importance.

Nelson[45] states that lymphopathia venerea in the *male* is usually characterized by inguinal adenitis, although elephantiasis of the genitalia does occur and rectal stricture is not rare. In the *female,* the characteristic lesions are: Chronic ulceration of the vulva, perineum, anus and rectum; fistula formation; and rectal stricture, their combination forming the genito-anorectal syndrome. Inguinal adenitis does occur, however, in some females.

The lymphopathic infection of the *urethral* mucosa may occur in different forms: as erosion, as superficial ulcer, and as seropurulent inflammation.

Kleeberg (1931)[32, 33, 34] describes a *stricture of a male urethra* in a case with a *positive Frei test,* and states his case was the *first one of urethral stric-*

*ture in lymphopathia venerea,* and compares this condition with the stricture of the rectum.

Touraine (1936)[52, 53, 54] differentiates a *"syndrome postérieur"* and a *"syndrome antérieur,"* according to the localisation of the lymphopathic lesion, besides the involvement of the entire genital area. The posterior syndrome is usually combined with an anorectal stricture. The anterior syndrome shows, in a similar way, a stenosis of the *urethra.* He describes a case of elephantiasis of the vulva without perineal lesions and without anorectal involvement, but with urethritis and subsequent *stricture of the urethra.* The Frei test was positive.

### PATHOLOGY OF STRICTURE FORMATION

It should again be emphasized that there is a variation in the form of the disease in men and women, *as result of differences in the distribution of the lymphatic drainage.*

A careful review of studies on the lymph supply of the male and female genitalia has shown that the lymph-nodal reactions of the disease are dependent on the lymph drainage.[1, 27] In the *male,* most of the lymph channels of the genitalia drain into the inguinal and, secondarily, into the deeper iliac nodes. Therefore, these nodes are the ones most often affected. *In the female, on the contrary, only the lymph from the clitoris and external vulva drains into the inguinal nodes while the supply from the vaginal mucosa, and especially from the posterior vaginal wall, drains into the lymph nodes around the rectum, where there are three lymph plexuses extending together up in the rectum to a height of from four to six centimeters.* Consequently, rectal stricture is much more common in females than in males, who suffer from this disease. Only the lower six centimeters of the rectum is involved as a rule, although it may extend upwards as high as ten centimeters. The tendency of the infection of the rectal and pelvic lymph nodes in the female is to produce an inflammation which spreads to the rectal walls through the lymph channels. Later, lymph obstructions take place. The end-result is inflammation and scar formation, with narrowing of the rectal lumen. The stricture may be band-like or, if all the lymph plexuses are involved, tubular in character.

The problem which presents itself is whether the well known stricture formation in the rectum in female cases of lymphopathia venerea allows us to assume that a urethral stricture in a female is analogous to the rectal condition. The above analysed lymph supply gives the explanation for the rectal stricture in females, where the lymph supply from the vaginal mucosa and posterior vaginal wall drains into the lymph nodes around the rectum. The lymphatics of the whole urethra in the female pass to the hypogastric nodes.[21] This is the reason why we do not find enlarged inguinal nodes in case of involvement of the urethra alone. A stricture of the urethra caused by lymphopathic disease can only be explained by a primary involvement of the urethral mucosa and the lymphatics in the immediate neighborhood.

In the rectal stricture the inflammation spreads to the rectal walls through the lymph channels *from the outside of the rectum.* In the urethra a primary involvement of the mucosa takes place, and the infection spreads through the lymph channels *from the urethral mucous membrane,* forming scars with stricture formation of the urethra as a result.

### THE VALUE OF THE FREI TEST

The diagnosis of lymphopathia venerea has been greatly simplified by the discovery Frei announced late in 1925.

In patients suffering from lymphopathia venerea, or in those who have previously had the disease, an intradermal injection of 0.1 cc. of his antigen produces an inflammatory papule within 24 hours, which persists for several days or longer. This specific cutaneous sensitivity lasts for many years, *perhaps during the life of the patient,* in other words, the patient develops an allergic state. One reported case showed a positive reaction after 23 years,[21] and another a positive reaction after 30 years.[2]

The fact that a patient is suffering from lymphopathia venerea does not prove that the lymphopathia venerea stands in causal relation to her urethral stricture. A case of proved lymphopathia venerea may develop an urethral stricture due to a trauma during a delivery, and in such a case we would find the combination of stricture of the urethra and a positive Frei test. In the case herein presented, there was no history of trauma and after a careful study of possible etiologic factors, all such causes for stricture of the female urethra can be excluded.

Study of the literature has shown that cases of primary and isolated lymphopathic infection of the urethra occur.[34, 44, 52, 53] We know that lymphopathia venerea affects the lymphatics, causing marked stricture formation. Therefore, the positive Frei test makes it more than probable that there is a causative connection between the urethral stricture and the lymphopathia venerea in this case. It is, therefore, advisable in any case of urethral stricture of unknown etiology to make a Frei test and, if positive, to reconsider the case from this angle. The test should also be made if the Wassermann reaction is positive, since fresh cases of lymphopathia venerea, for a period of time during the acute stage of the disease, occasionally will give false positive Wassermann reactions.[2] This is a very important finding, as a 3-plus Wassermann reaction in a patient with lymphopathia venerea might easily be mistaken for syphilis and treatment instituted.

### TREATMENT

Kelly[30] says a stricture of the urethra may be treated by one of the following methods: Electrolysis, rapid dilatation, slow dilatation, incision and dilatation, and excision.

If the stricture is not too tight nor spread over too large an area, it may be treated by rapid dilatation, putting the patient under gas anesthesia and passing Hegar dilators until the canal is enlarged by two to three millimeters in diameter, or up to the size of the average glass catheter, six to seven

millimeters. After this preliminary rapid dilatation, gradual dilatation, with sounds, bougies or Hegar dilators should be used over a considerable period of time. This operation is carried out after a local anesthetic has been applied to the urethral mucous membrane. The dilating instruments should be generously lubricated before insertion and the largest instrument passed at any sitting should be left in place for 10–15 minutes. The size of the dilators used must be determined each time by the degree of pain caused. It is necessary to avoid any severe pain as the treatment must be so frequently repeated, and, also, to avoid trauma. At first daily treatments are given, but later the intervals between sittings can be increased and the treatments should be continued over a period of several months.

These patients ought to be warned that recurrences are common, and that for this reason they are to return several times a year for dilatation. In some cases reported the dilators were left in place for six hours. If the patient is sufficiently intelligent it is a good plan to give her a dilator of the largest size and instruct her how to sterilize it, to cleanse the parts and to introduce it well oiled. This she ought to do every day and report for further examination several weeks later.

In the presented case we treated the patient by rapid dilatation. Under gas anesthesia, the urethra, which only admitted a filiform ureteral catheter, was dilated gradually up to a No. 37 metal dilator. A retention catheter was left in place and a dilatation under local anesthesia was repeated, first daily and later at longer intervals. Now, after three months, the patient is coming for treatment every other week. She feels perfectly well and passes water without any difficulty.

SUMMARY

(1) A high-degree stricture of the female urethra in a case with positive Frei test has been presented.

(2) The involvement of the female urethra in lymphopathia venerea has been discussed.

(3) The differences in the pathology of rectal and urethral strictures have been pointed out.

(4) The value of the Frei test as an etiologic guide, and the probability of the lymphopathic origin of the presented case has been discussed.

(5) The Frei test in each case of urethral stricture of doubtful etiology has been suggested.

(6) The treatment of strictures of the female urethra has been described.

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# SERUM AMYLASE FINDINGS IN CHRONIC ALCOHOLIC PATIENTS WITH ACUTE, SEVERE ABDOMINAL SYMPTOMS

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THE PURPOSE of this paper is to emphasize the significance of the high serum amylase values found in a small group of patients admitted to the Surgical Wards of Harlem Hospital "for observation" suffering some apparent severe intra-abdominal condition.

All the patients gave a history of chronic alcoholism and the symptoms upon admission were: vomiting, severe pain in the epigastrium, and, on physical examination, they showed marked rigidity of the abdominal muscles, especially in the upper half of the abdomen, with or without tenderness in the epigastrium. In this type of case members of the Staff have usually made the diagnosis of "acute alcoholic gastritis," while not infrequently the patient has been subjected to an unnecessary exploratory celiotomy for a possible surgical lesion.

Clinically, at times, the lesion seemed to be located in the stomach, while in other cases the pancreas was apparently involved. The last alcoholic debauch evidently precipitated changes in a digestive system that had been impaired by the prolonged excessive use of alcohol. Certainly, the symptoms in some of the patients were much more severe than could be explained on the basis of simple acute gastritis superimposed upon chronic gastric pathology. As a matter of fact, the symptoms were so catastrophic in character that they could be explained on an anaphylactic basis.

TABLE I

SERUM AMYLASE FINDINGS IN 11 ALCOHOL PATIENTS WITH ACUTE ABDOMINAL SYMPTOMS

| Case No. | Operation | Serum Amylase Readings | Urine Amylase Readings | Peritoneal Fluid Amylase Readings |
|---|---|---|---|---|
| Case 1 | Findings: Thin sanguineous fluid in abdominal cavity. Edema about pancreas | | | |
| Case 1 (Readmission) | None | 340 S.U. | | |
| Case 2 | None | 607 S.U. | | |
| Case 2 (Readmission) | Findings: Thin sanguineous fluid in abdominal cavity. Edema about pancreas | 844 S.U. | | 415 S.U. |
| Case 3 | Findings: Thin sanguineous fluid in abdominal cavity. Edema about pancreas | 350 S.U. | 353 S.U. | 990 S.U. |
| Case 4 | Findings: Thin sanguineous fluid in abdominal cavity. Edema about pancreas | 268 S.U. | | |
| Case 5 | None | 488 S.U. | | |
| Case 5 (Readmission) | None | 348 S.U. | | |
| Case 6 | None | 942 S.U. | 700 S.U. | |
| Case 7 | None | 385 S.U. | 1524 S.U. | |
| Case 8 | None | 455 S.U. | | |
| Case 9 | None | 332 S.U. | | |
| Case 10 | None | 280 S.U. | | |
| Case 11 | None | 370 S.U. | | |

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The material upon which these studies were based was obtained on 11 patients, as shown in Table I. Four operations were performed, and in each instance edema about the pancreas was noted, and the peritoneal fluid was of a thin sanguineous character. In the remaining seven cases the high amylase findings were the chief factor in deciding against operative intervention. These seven cases were discharged well. In Cases 2 and 3, amylase readings were made of the peritoneal fluid in addition to the readings in the serum, while in Cases 3, 6 and 7 determinations were also made on the urine. The peritoneal fluid readings and urine amylase readings were above normal.

Wright[1] found, roentgenologically, when cats were fed with a barium carbohydrate, barium protein, or barium fat mixture, to which large doses of alcohol had been added, that the rate of discharge from the stomach was greatly delayed. The chemicophysiologic basis for this mechanism is not entirely clear, but it involves local effects on the organs of the digestive system as well as action on the central nervous system.

It is well known in man that the consumption of large quantities of alcohol causes a transient stimulating action rapidly followed by grave depression. Berry[2] made gastroscopic studies on a large number of chronic alcoholic patients and noted definite changes in the gastric mucosa, which proved the existence of a chronic alcoholic gastritis.

Clark[3] studied 36 cases at autopsy, and found that there was a definite relationship between habitual drunkenness and pancreatitis. He noted inspissated or coagulated secretions in the pancreatic duct of 36 cases; combined with this was dilatation of smaller ducts in areas of fibrosis. A review of the histories of many patients with pancreatic cysts has shown that they were heavy consumers of alcohol.

The cause of elevated amylase in the serum of human beings is considered to be due to rapid destruction of the acinar membranes of the pancreas and the sudden overflow in the immediate surrounding pancreatic tissue which cannot hold or confine it; the enzyme thus escapes into the blood stream. Its presence in the urine and peritoneal fluid can be explained on the same basis.

COMMENT.—In Table I it is seen that operation was performed in four instances and in these four patients edema was present about the pancreas. Operation was avoided in seven instances in the presence of severe abdominal signs and symptoms, and the patients recovered without surgery. Three cases represented readmissions, and in all three instances there were persistently high urine amylase readings.

### CASE REPORTS

**Case 1.**—J. E., male, chronic alcoholic, admitted January 20, 1939, was operated upon for a possible ruptured ulcer. At operation, the diagnosis of acute pancreatitis was made. One month later he was readmitted with a similar history and complaint, but this time an elevated amylase prevented a repetition of the first error.

*History.*—Patient is a chronic alcoholic who entered with an attack of severe abdominal pain following a drinking bout. He was taken to another hospital where a

diagnosis of ruptured peptic ulcer was made, but patient refused celiotomy. He was then brought to Harlem Hospital where the diagnoses were made of: 1, ruptured appendix with generalized peritonitis; 2, ruptured peptic ulcer.

*Operation.*—Findings: Large amount of thin hemorrhagic fluid found in the peritoneal cavity. The pancreas was found to be edematous and enlarged. The diagnosis of acute hemorrhagic pancreatitis was made.

*Course.*—Patient developed delirium tremens and was transferred to Bellevue Psychiatric Ward. *Final Diagnosis:* Acute hemorrhagic pancreatitis.

*Second Admission,* February 19, 1939.

*History.*—Chronic alcoholic admitted with severe abdominal pains of nine days' duration. There had been persistent vomiting. Abdomen was distended and rigid. There was marked direct and rebound tenderness present. *Diagnosis:* Acute pancreatitis.

*Laboratory.*—Kahn, negative. Urine, occult blood, albumin 2 plus. *Amylase*—Serum, February 19, 1939, 340 S. U.

*Course.*—Continued improvement until discharged February 26, 1939. *Final Diagnosis:* Acute pancreatitis.

**Case 2.**—D. W., male, age 38, was admitted January 15, 1942. He was a chronic alcoholic who entered with symptoms of an acute abdomen. Many diagnoses were made, but a serum amylase of 607 Somogyi units indicated the correct diagnosis and prevented operation. This patient was readmitted one month later, with a similar history and symptoms, but this time he unfortunately came to operation. At operation, the diagnosis of acute pancreatitis was made. The amylase readings were elevated on both plasma and abdominal fluid taken at operation. Patient went into shock and expired.

*History.*—Patient is a chronic alcoholic, and was admitted after suffering sudden abdominal pain. He entered with spasticity and moderate rigidity and tenderness in abdomen. The diagnoses made were: 1, acute abdomen.; 2, left diaphragmatic pleurisy; 3, ruptured appendix, with peritonitis; 4, cholecystitis or pancreatitis; 5, left subphrenic abscess; 6, lobar pneumonia.

*Laboratory:* Kahn, 4 plus. Urine, normal. Chemistry, normal. Roentgenograms showed elevated left diaphragm and questionable pneumonia. *Amylase*—January 15, 1942, 607 S. U.; January 23, 1942, 485 S. U.; February 2, 1942, 10 S. U.

*Final Diagnosis:* 1, Pancreatitis; 2, lues.

Second Admission, February 20, 1942.

*History.*—Following a period of heavy drinking he was seized with epigastric pain just to the left of the midline, which radiated along left costal margin. Abdomen was board-like, with marked rebound tenderness. *Diagnosis:* Ruptured ulcer.

*Operation.*—Findings: One liter of serosanguineous fluid in peritoneal cavity. No other pathology found. Operative Diagnosis: Acute pancreatitis.

*Laboratory.*—Kahn, 4 plus. Urine, negative. Chemistry, negative. Roentgenologic, essentially negative. *Amylase*—February 20, 1942, plasma 844 S. U., peritoneal fluid 415 S. U. February 24, 1942, plasma 297 units.

*Course.*—Patient went into shock on February 25, 1942, and expired. *Final Diagnosis:* Acute pancreatitis.

**Case 3.**—W. W., male, age 30, was admitted March 9, 1942. The patient was a bartender and was admitted with a diagnosis of acute appendicitis or possible perforated peptic ulcer. At operation, the diagnosis of acute pancreatitis was made. It is significant that amylase readings on abdominal fluid at operation was 990 S. U. whereas the plasma value the following day was only 185 units.

*History.*—Patient was seized with severe abdominal pain, following heavy drinking. Abdomen was flat, with slightly increased resistance in lower half, more rigid in upper one half. Diagnosis: 1. Acute appendicitis. 2. Possible perforated peptic ulcer.

*Operative Findings.*—Approximately 300 cc. of hemorrhagic fluid in the peritoneal cavity. Abdomen was closed after inspection of viscera revealed no other pathology.

*Laboratory.*—Kahn—negative. Urine—negative. Chemistry—normal. Roentgenograms of abdomen—essentially negative. *Amylase*—Abdominal fluid 990 units, March 10, 1942. Blood plasma 185 units, March 11, 1942. Blood plasma 350 units, March 16, 1942. Urine 353 units, March 17, 1942.

*Course.*—Discharged March 31, 1942. *Final Diagnosis:* Acute pancreatitis.

**Case 4.**—H. C., male, age 38, was admitted February 24, 1942. The patient was a chronic alcoholic, and entered with a diagnosis of intestinal obstruction. At operation the diagnosis of acute pancreatitis was made. ***Serum amylase,*** two days postoperative, was 268 S. U. Patient died on fourth postoperative day.

*History.*—The patient is a chronic alcoholic and entered with severe abdominal pain. Vomited several times. Abdominal scar from previous stab wound. Obstipation of two days duration. Diagnosis: Acute intestinal obstruction.

*Operative Findings.*—Serosanguineous fluid in abdominal cavity. Hepatic end of transverse colon edematous and hemorrhagic. Fat necrosis on under surface of transverse mesocolon.

*Laboratory.*—Kahn—negative. Urine—negative. Chemistry—normal. *Serum amylase* 268. Roentgenograms of abdomen—negative. W. B. C. 12,200, 84% polynuclears.

*Course.*—Postoperatively, the patient developed delirium tremens, and died on the fourth postoperative day. *Final Diagnosis:* Hemorrhagic pancreatitis.

**Case 5.**—M. H., female, age 22, was admitted March 25, 1941, with the history of chronic alcoholism and complained of pain in abdomen radiating to the back. Rigidity in right upper quadrant. Liver enlarged. Diagnoses: 1. Acute catarrhal jaundice. 2. Toxic hepatitis. 3. Gastroenteritis. 4. Acute pancreatitis. 5. Intestinal obstruction. 6. Rupture of sigmoid colon.

*Laboratory.*—Kahn—negative. Urine—negative. Icteric index 6.6. van den Bergh—negative. *Amylase*—March 20, 1941, plasma, 488 S. U. March 26, 1941, plasma, 281 S. U. March 27, 1941, plasma, 114 S. U. April 3, 1941, plasma, 106 S. U.

Patient discharged April 8, 1944, without complaints.

Second Admission, September 21, 1943.

*History.*—Severe abdominal pain and vomiting, following long period of drinking. Patient entered with mild shock, abdomen distended. Liver edge palpated, abdomen tense and tender. Diagnosis: Acute alcoholic pancreatitis.

*Laboratory.*—Roentgenogram for air under diaphragm—negative. *Amylase*—Serum 348 S. U., September 21, 1943.

Patient signed out A. O. R. September 22, 1943. *Diagnosis:* Acute alcoholic pancreatitis.

**Case 6.**—C. M., female, age 25, was admitted September 5, 1941.

*History.*—Patient was seized with abdominal pain, cramps and vomiting following heavy drinking, and entered in mild shock, pulse thready and almost imperceptible. Abdomen tense, distended, and rigid. Mouth and tongue showed evidence of avitaminosis. Diagnoses: 1. Intestinal obstruction. 2. Retroperitoneal infection. 3. Acute pancreatitis. 4. Acute cholecystitis. 5. Early acute appendicitis.

*Laboratory.*—Kahn—4 plus. Urine—essentially negative. *Amylase*—Serum, September 5, 1941, 942 S. U.; plasma, September 6, 1941, 360 S. U.; urine, September 6, 1941, 700 units per hour excretion of 70 cc.; plasma, September 10, 1941, 70 S. U.

*Final Diagnosis.*—On discharge September 22, 1941, acute pancreatitis. Lues.

Second Admission March 14, 1942.

Readmission, with similar symptoms of pain in the epigastrium. This time she was placed in a medical ward where she remained for four days. Urine and chemistry normal. She was discharged with final diagnosis of alcoholic gastritis.

**Case 7.**—J. T., male, age 38, was admitted September 24, 1942. The patient entered with a rigid abdomen, and a history of drinking cheap liquor. Diagnoses: 1. Acute alcoholic gastritis. 2. Chronic alcoholic gastritis.

*Laboratory.—Amylase:* Plasma, September 24, 1942, 385.5 S. U. September 25, 1942, 364 S. U. Urine, September 25, 1942, 1524 S. U.; September 26, 1942, 1524 S. U. Plasma, September 29, 1942, 524 S. U.

*Final Diagnoses:* Acute alcoholic gastritis. Acute pancreatitis.

**Case 8.**—J. P., male, age 34, was admitted June 6, 1942, complaining of abdominal pain following period of excessive drinking. Abdomen rigid with direct and rebound tenderness. Diagnosis: Acute gastritis.

*Laboratory.*—Kahn—negative. Urine—negative. Roentgenograms of abdomen—negative. *Amylase*—Plasma 455 units.

*Final Diagnosis.*—Acute pancreatitis.

**Case 9.**—E. G., female, age 32, was admitted May 6, 1943. The patient was a chronic alcoholic, and entered complaining of frequent attacks of vomiting, and pain in the abdomen. She entered hospital two weeks after onset. Diagnoses: 1. Chronic recurrent pancreatitis. 2. Possible peptic ulcer.

*Gastroscopy.*—Impression—chronic gastritis.

*Laboratory.*—Kahn—negative. Urine—negative. Chemistry—negative. *Amylase*—332 units, May 6, 1943.

*Final Diagnoses.*—Chronic gastritis. Chronic pancreatitis.

**Case 10.**—D. P., male, age 23, was admitted May 6, 1942, with the history of alcoholic excesses for two weeks. Abdominal pain. Rigidity in both upper quadrants. Diagnoses: 1. Acute cholecystitis. 2. Acute appendicitis. 3. Acute abdomen. 4. Pancreatitis. 5. Gastritis. 6. Hepatitis.

*Laboratory.*—Kahn—negative. Urine—negative. Chemistry—negative. Roentgenograms of abdomen—negative. *Amylase*—Plasma, May 6, 1942, 280 units.

*Course.*—Improvement until discharge on May 17, 1942. *Final Diagnosis:* Gastritis.

**Case 11.**—L. C., male, age 31, was admitted April 6, 1944, complaining of severe abdominal pain following over-indulgence of alcohol. Vomiting present. Diagnoses: 1. Ruptured gastric ulcer. 2. Acute pancreatitis.

Abdominal tap: Thin hemorrhagic fluid.

*Laboratory.*—Roentgenograms of abdomen revealed no air under the diaphragm. *Amylase*—Abdominal fluid, 370 units.

Patient left hospital symptom-free the next day.

## CONCLUSION

Serum amylase determinations should be made on all chronic alcoholic patients if operative intervention is contemplated because of severe, acute abdominal symptoms.

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# MYOBLASTOMA

## CASE REPORT

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TUMORS of the myoblastoma group are being recognized with increasing frequency during recent years and criteria for their classification are pending. The chronologic history of these lesions is relatively brief, the first cases being described in 1926 by Abrikossoff.[1] Klemperer,[2] in 1933, reviewed the subject, discussing 44 cases and adding six new ones of his own. Horn and Stout,[3] of Columbia, in 1943, reported two more cases and reviewed 120. In September of 1944, Warren and Howe[4] reported ten new cases, and reviewed and classified all cases reported to that date, bringing the total to 155.

The typical tumor cell in myoblastoma is a large, pale, faintly acidophilic cell, polyhedral in shape and granular in cytoplasm, which is sometimes vacuolated. Nuclei are relatively uniform in size, shape and staining reaction, and mitotic figures are rare. The cells are frequently seen arranged in a pseudo-alveolar or organoid fashion and sometimes in bands or bundles surrounded by a delicate fibrous tissue stroma. They may resemble xanthoma cells, but staining with scharlach R fails to reveal lipoid material. Cross-striations may be present. In event that these cross-striations are present in appreciable number, Howe and Warren[4] believe them better classified as rhabdomyomata or rhabdomyosarcomata. Often a definite capsule is present, but if absent, the tumor cells blend almost imperceptibly with the adjacent muscle cells.

Abrikossoff originally classified myoblastic tumors into four types: Type I being tumors composed of myoblasts with no striations. Type II included cells similar to Type I but with rare longitudinal or cross-striations. Type III was composed of tumors with markedly hypertrophic myoblasts (40–160 micra in length), often multinuclear and syncytial in form. Type IV lesions were tumors which were all typical myoblastic sarcomata, the cells of which showed pleomorphism, with some areas showing differentiation with striations, and others being frankly sarcomatous. Howe and Warren classify Type IV tumors as frank rhabdomyosarcomata.

Generally speaking, malignant and invasive myoblastic tumors are rare, and metastases *via* either lymph or blood stream are unusual. In only 11 per cent of total cases reported was malignancy found, and of these only three showed metastases, the common sites being regional lymph nodes and lungs. Fifty-six per cent of cases, exclusive of Klemperer's series, occurred in the upper respiratory and digestive tracts (114 cases). From the total of 155 cases in the literature 59 were tumors of the tongue, 13 of the oral cavity, 10 of the subcutis, and 73 of the rest of the body.

Some myoblastic tumors are associated with epidermoid malignancy. These usually occur in the upper respiratory tract, mouth (tongue particularly) and skin. In 45 per cent of the 29 cases in which information is available there was excessive epithelial hyperplasia overlying the tumor, and in 28 per cent frank carcinoma.

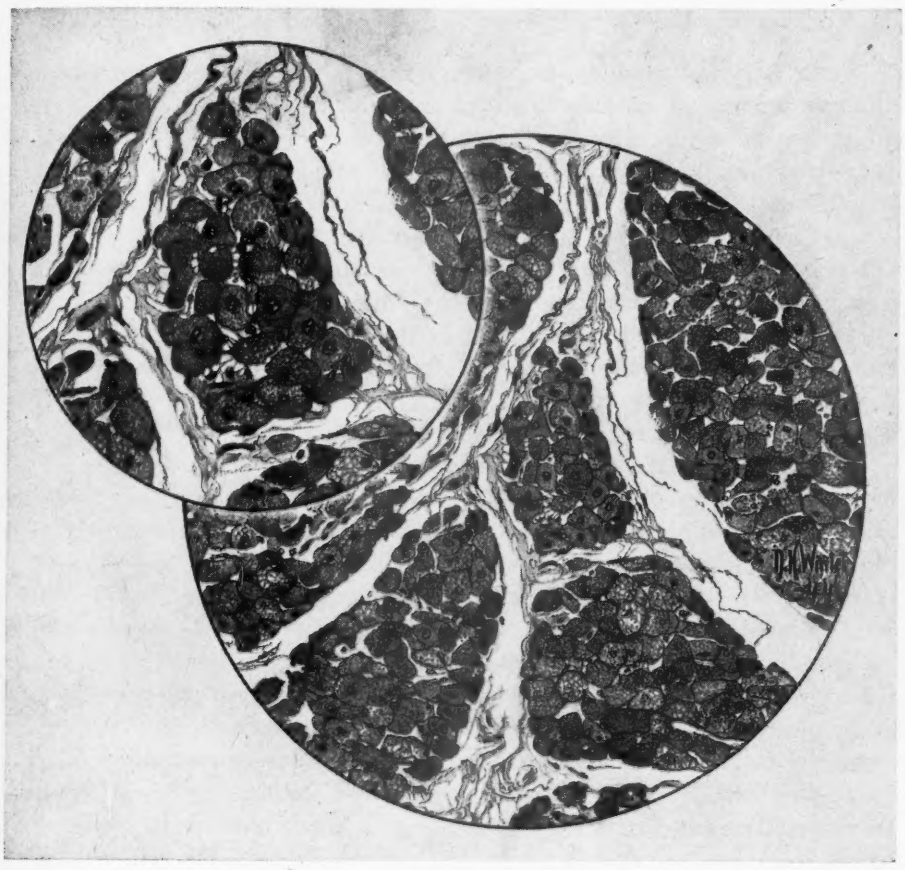

FIG. 1.—Drawing showing cellular structure and pseudo-alveolar arrangement of myoblastoma cells. Inset shows higher power magnification.

**Case Report.**—Mrs. R. E. J., age 48, was admitted to the University of Kansas Hospitals complaining of a mass in the left back, which she first noticed about seven months before. During the past three months the mass has grown rapidly. Some discomfort was noticed when the patient lay on the left side, but there has been no pain.

*Physical Examination.*—A smooth mass was found in the posterior axillary line over the ninth rib, measuring about 5 x 7 cm. It was freely movable on the chest wall and beneath the skin. The consistency was somewhat firmer than that of an ordinary lipoma. A clinical diagnosis was made of a deep-lying lipoma.

*Operation.*—Under local anesthesia, the mass was removed. It lay in the anterior margin of the left latissimus dorsi muscle, and was definitely encapsulated.

*Gross Pathology.*—The specimen consists of a roughly-flattened, encapsulated, spheroidal piece of tissue, measuring 6 x 6 x 2 cm. It is soft, spongy and elastic in con-

sistency. The cut-surface of the specimen appears quite meaty, being made up of pale brown fasciculi of tissue closely resembling striated muscle with little stroma.

*Histopathology.*—The sections are found to be composed of masses of peculiar polyhedral cells separated by a fine, loose fibrillar stroma and arranged in irregularly shaped lobules. These cells are large, pale and moderately eosinophilic, with coarsely granular, often vacuolated cytoplasm. Nuclei are central in location, uniform in morphology, and without mitoses. Masson's stain colors these cells orange-brown, indicating their parenchymatous nature. Striations could not be demonstrated (Fig. 1).

There has been considerable controversy over the origin and pathogenesis of these tumors. Two basic theories are promulgated: That of embryonal origin, which is supported by Schirmer,[6] Kraneis[7] (cited by Gander), and Jaulin and Grandclaude;[8] and that of excessive regeneration of injury (Abrikossoff,[1] and Gander[9]). Ducuing, *et al.*[10] even include syphilis as a possible cause. Gander goes to the point of accepting an embryonal origin for "granular cell rhabdomyoma" in all regions but the tongue, and postulates a traumatic origin of myoblastic tumors in this organ.

Horn and Stout adhere to the myogenous theory of origin, even though tumors have been reported arising in regions where no striated muscle is normally present. In such case, they assume that the lesions arise from embryonal rests of aberrant myoblastic tissue.

The reason for the indecision as regards the origin of these myoblastic lesions apparently lies in two cytologic peculiarities; one being the presence of tumor cells in regions where no striated muscle is normally found. The other reason is the occurrence of striated muscle cells which are of normal-appearing structure in one region and in others have undergone a change which strongly resembles the granular structure of the myoblastic tumor cells.

Diss,[11] in reporting a myoblastoma of the tongue, explains this growth in the following manner: "The muscular fibers apparently in process of undergoing granular transformation are not a part of the true tumor. These are elements which have undergone a peculiar granular degeneration, and conserve their fertility and become neoplastic. In multiplying, these granular cells conserve their characteristics, reach the mucosa, and fill its papillae."


## SUMMARY

1. A case of myoblastoma (Abrikossoff-Type I) arising in the deep muscles of the back is reported.

2. Classification of these lesions is at present in a state of flux; a modification of that of Abrikossoff[5] being now most applicable.

3. Myoblastic tumors are becoming more frequently recognized.


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# BRIEF COMMUNICATION

## EPIPLOIC APPENDICITIS: A CAUSE OF LEFT-SIDED ABDOMINAL PAIN

CASE REPORT

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THIS CASE IS REPORTED because it adds another to a list of about 62 published instances of acute inflammation of the epiploic appendages, and because the presence of nondescent of the left testicle in our patient made it necessary to consider torsion of an intra-abdominal testicle in the differential diagnosis.

**Case Report.**—Case No. 428802: D. B., male, age 31, a factory worker, was seen in the Out-patient Department, October 5, 1944. He complained of lower abdominal discomfort of three days duration, described vaguely as "gas pains." The pain became fairly well localized in the left lower quadrant. There had been no nausea or vomiting but his appetite had been poor for two days. There were no urinary symptoms.

*Physical Examination.*—The patient was moderately obese. The temperature and pulse were normal. There was exquisite tenderness in the left lower quadrant, with muscle spasm, rebound tenderness and cutaneous hyperesthesia. The left testicle was absent from the scrotum and inguinal canal; the patient stated that it had never been palpable. There were 10,200 white blood cells, 65 per cent polymorphonuclears.

The following preoperative diagnoses were considered: (1) Torsion of intra-abdominal testicle; (2) sigmoid diverticulitis; and (3) left-sided vermiform appendicitis. Dr. John K. Ormond, urologist, was consulted and he agreed that torsion of the undescended testicle was a likely diagnosis. He had seen and reported a case with this condition on the right side.[8]

*Operation.*—Under ethylene anesthesia, a low "left McBurney" incision was made and the peritoneal cavity was opened. Exploration encountered a firm mass which proved to be attached to the sigmoid. After some difficulty, it was delivered into the wound and it was found to consist of a markedly inflamed epiploic appendage which was attached by fibrinous adhesions to neighboring appendages. It was bluish-red in color. When the other structures had been separated from it, its attachment was found to consist of only a small pedicle. It was feared that this pedicle might contain the lumen of a diverticulum, so it was treated like the stump of the vermiform appendix by ligature and inversion. The inversion into the inflamed wall of the sigmoid was only moderately satisfactory. No mucous membrane was seen when the appendage was amputated, however.

A search was made for the missing testicle. The vas deferens was located and followed to its distal end, where a rudimentary structure was found and removed. This was done because of the known tendency of the intra-abdominal testicle to undergo malignant change. The wound was closed with drainage. The postoperative course was uneventful, and the patient was discharged on the tenth day. He returned to work in three weeks.

*Pathologic Examination.*—Dr. Frank W. Hartman: "The specimen consists of a disk of tissue, measuring 3 cm. in diameter and 1 cm. in thickness. It is covered by a serous membrane. When cut, it is seen to be composed of lobulated, reddish-gray, firm

tissue. *Microscopic:* Sections taken through the discoid piece of tissue submitted showed that it was composed of lobulated adult fat. There has been considerable extravasation of red blood cells into the intercellular tissue. Throughout the mass there are engorged vascular channels. Along one side there is a thick layer of pink-staining fibrillar tissue through which are distributed some fibroblasts and small round cells. *Impression:* Cellulitis of epiploic appendage."

COMMENT.—The correct diagnosis was not suspected preoperatively. To our knowledge, there is only one instance of a correct diagnosis. Fiske[1] reported that Dr. Wayne Babcock was able to do this in one case. The appendices epiploicae may have more surgical significance than is generally recognized. For further details, the reader is referred to the appended bibliography.

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# BOOK REVIEW

ESSENTIALS OF ORAL SURGERY. By Vilray P. Blair, M.D., and Robert K. Ivy, M.D., 3rd Edition: C. V. Mosby Co. St. Louis. 1944.

This book was originally published in 1923, of which this is the third edition. The original edition utilized much of the material from Blair's "Surgery and Diseases of the Mouth and Jaws," originally published in 1912. The present Third Edition has revised and brought up to date the chapters on wounds, shock, hemorrhage, burns and anesthesia. The section on fractures of the jaws have included some of the newer technics of fracture wiring, cast and plastic splints and the use of skeletal fixation extra oral splints.

This book has previously been used quite extensively by dental students in the colleges. The section on the extraction of teeth and especially that portion dealing with impacted teeth, could be revised and made more complete if it is to be most useful to the undergraduate or graduate dental student. The addition of a more complete bibliography would have greatly improved this edition.

This book does not pretend to be a complete text on the subject of Oral Surgery, but as its title implies, it covers the essentials. It should be a useful review of the essentials of Oral Surgery for the general practitioner and the student, and should find a place in the library of the physician and the dentist.

DOUGLAS B. PARKER, M.D.

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